5.1.6 Construction Methods and Schedule

(1) Dredging Plan

1) Selection of Dredger Type

The total dredging volume for widening and deepening of the channel and basin of Tanjung Priok Port amounts to over 20 million cubic meters in Phase I development of North Kalibaru. In order to complete the required dredging works in the limited work period, a dredging method with high productivity should be selected.

Since the sediment material around the port development areas in Java Sea is clay or silt, mechanical/hydraulic dredgers (cutter suction dredger and trailing suction hopper dredger are representative) are usually employed on construction and maintenance purposes of channel and basin. They are characterized by high production rates and mobility.

Out of these dredgers, Trailing Suction Hopper Dredger (TSHD) is used mainly for the maintenance dredging of channels and specializes in dredging ‘soft and loose’ deposit material.

In the actual maintenance dredging of the channel and basin of Tanjung Priok Port, large portions of the dredging work are carried out by TSHD. And Grab Bucket Dredgers are used as well in front of the quay walls or narrow slips of the water area where TSHD cannot enter.

Meanwhile, in the case of initial dredging of channel and basin to be excavated newly, the deposit material is consolidated after compaction. The use of Cutter Suction Dredger is considered more suitable than TSHD.

Hence, the combination of Cutter Suction Dredger and hopper barge is applied in the port development project as the economical dredging method with high productivity.

Use of Grab bucket dredger will be effective in the dredging works of deepening and expansion of the harbour basins and channel.

2) Disposal Plan of Dredged Material

Tanjung Priok

The water area that is designated by ADPEL as the dumping site for the dredged material from Tanjung Priok Port has been located in the area called Muara Gembong and was defined by the following coordinates (refer to Figure 5.1.6-1);

05º 56’ 09”S, 106º 59’ 24”E ～ 06º 00’ 42”S, 106º 58’ 30”E

The existing dumping site has been located in the shallow water area with water depth from 5 meters to over ten meters in the eastern part of Jakarta Bay. Considering the influence of advection diffusion of turbidity to the fisheries and/or the problem of returning of the disposed material to the water area around Tanjung Priok, the existing location was judged as not appropriate.

According to a recent instruction by ADPEL (Adpel Utama Tanjung Priok, 10th February 2010), the new dumping site is designated at a new location in the water area offshore Karawang, where the water depth is around 30 meters. Distance between the new dumping site and Tanjung Priok Port is around 26 km (14 nautical miles). The geographical location is given by the coordinates as follows (refer to Figure 5.1.6-2).

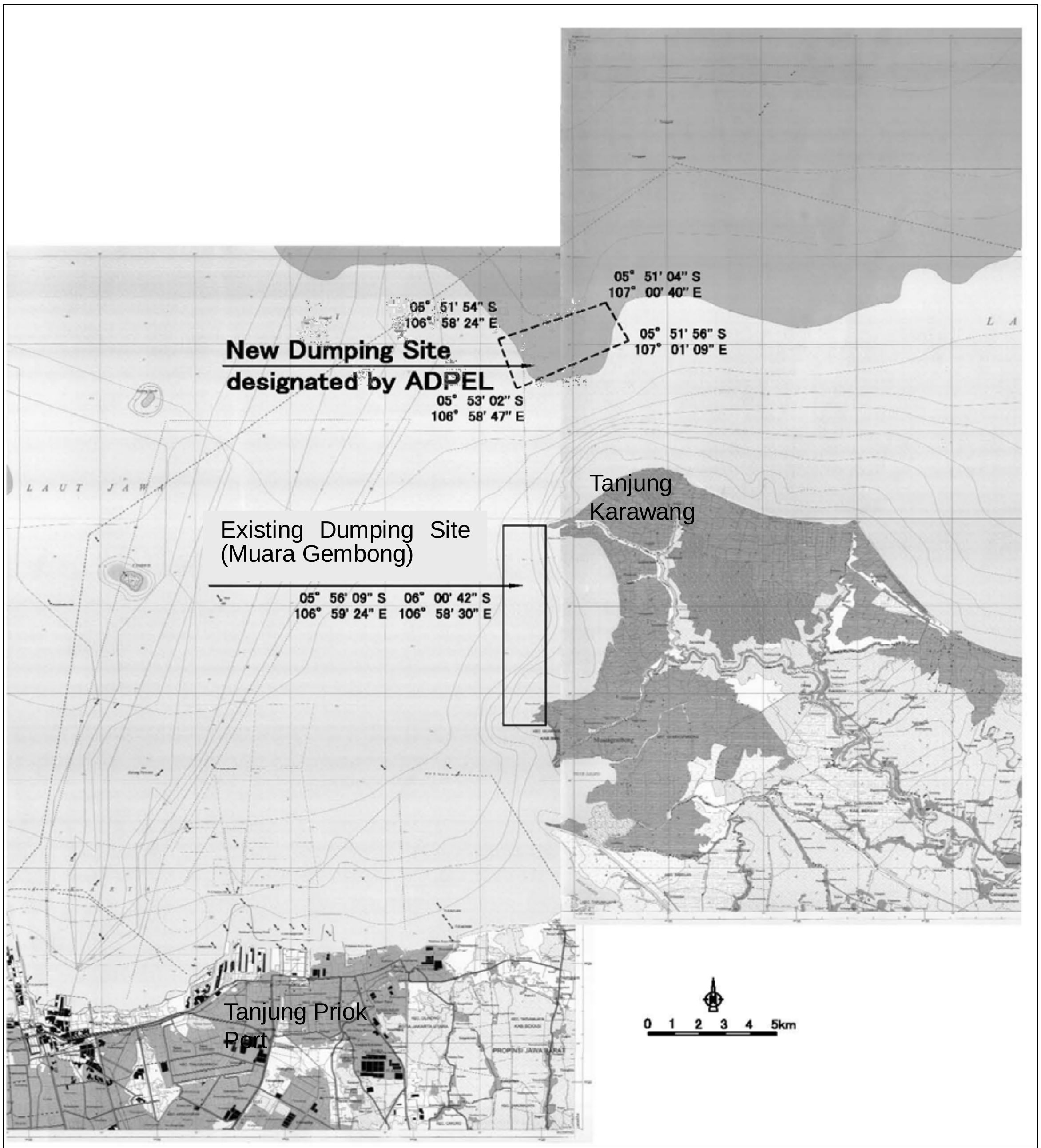
1. 05º 51’ 54”S, 106º 58’ 24”E
2. 05º 51’ 04”S, 107º 00’ 40”E
3. 05º 51’ 56”S, 107º 01’ 09”E
4. 05º 53’ 02”S, 106º 58’ 47”E

Proposed Dumping Site for Cilamaya and Tangerang Development

In the construction planning of this study, new locations of the dumping site for the container terminal development projects are planned offshore Cilamaya and Tangerang at the water depth over 30 meters. Reference is made to Figure 5.1.6-2.

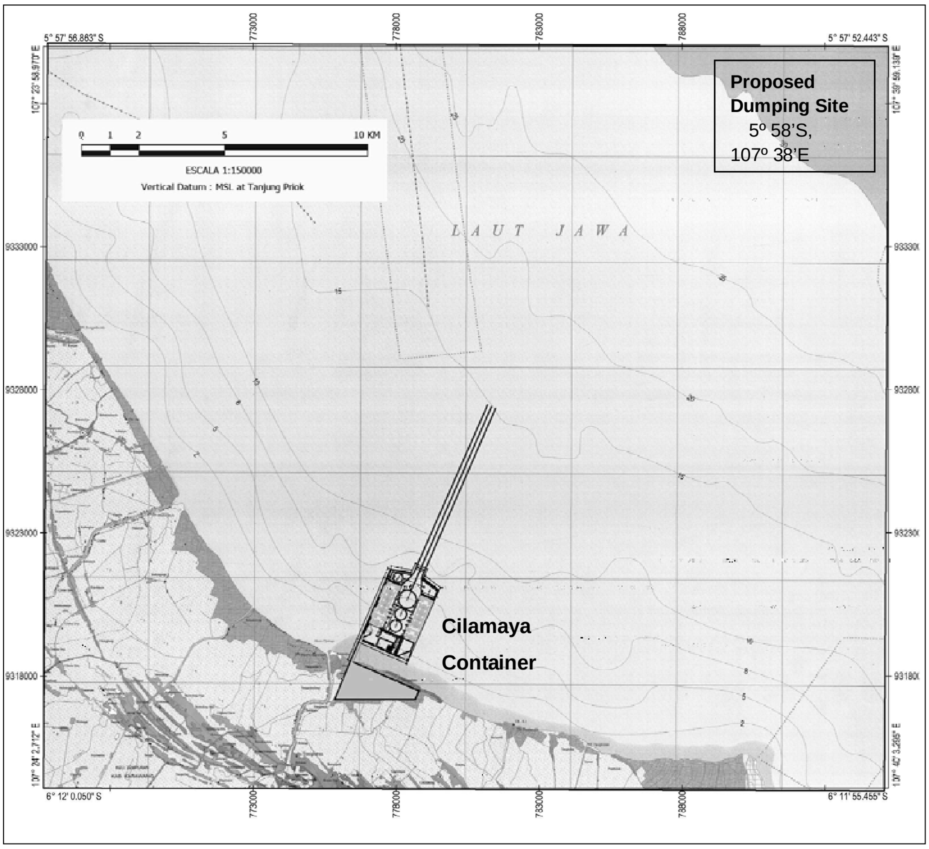
The distance between the site of Cilamaya Container Terminal and the proposed dumping site is 22 km (around 12 nautical miles).

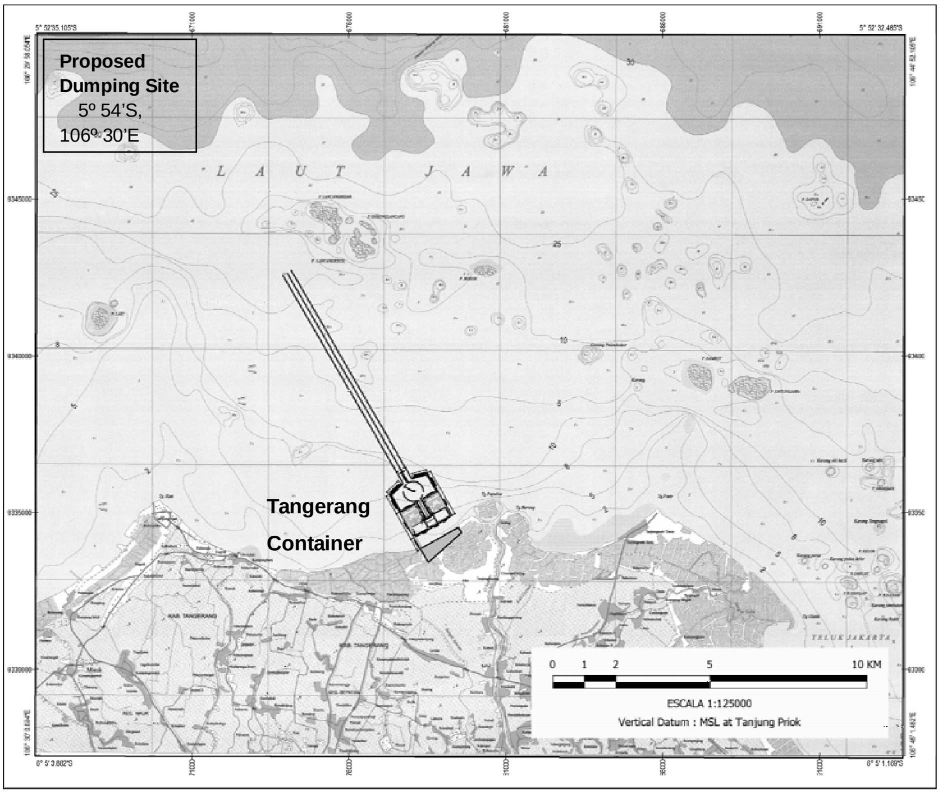
The distance between the site of Tangerang Container Terminal and the proposed dumping site is 18 km (around 10 nautical miles).



(Distance between Tanjung Priok and New Dumping Site = 26 km, around 14 nautical miles)
Source: JICA Study Team

Figure 5.1.6-1 Dumping Site of Dredged Material from Tanjung Priok Terminal





(Distance between Site and Dumping Site = 18 km, around 10 nautical miles)
Source: JICA Study Team

Figure 5.1.6-2 Dumping Sites of Dredged Material from Cilamaya and Tangerang

3) Productivity of Dredging Plans

Proposed Dredger Fleet

Dredger fleet for the dredging works of channel and basin at Tanjung Priok Port and other development site as well is planned as follows.

As for the dredger vessels, most of the dredgers will be procured domestically except for the special purpose dredger or very large scale Trailing Suction Hopper Dredgers, which are available from Europe. The following Table 5.1.6-1 gives the list of active dredgers owned and operated by PT RUKINDO, a state-owned dredging company.

A dredger that is equivalent to the maximum cutter suction dredger actually operated by PT RUKINDO is assumed for the works. This is due to difficulty in mobilizing a dredging fleet from distant areas such as Singapore or Europe.

Table 5.1.6-1 List of Dredger Vessels of PT RUKINDO and their Dimensions

(1) Trailing Suction Hopper Dredgers

	Name of Ship	Year Built	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Loaded Draught (m)	Total Installed Power (HP / kW)	Dredging Depth (m)	Hopper Capacity (m^3)
1	BALI II*	1993	124.40	18.04	8.05	7.00	6,800/7,300	30	5,000
2	ARU II*	1994	124.40	18.04	8.05	7.00	6,800/7,300	30	5,000
3	IRIAN JAYA	1981	109.88	18.04	8.05	6.33	5,386	20	4,000
4	KALIMANTAN II	1981	109.88	18.04	8.05	6.33	5,386	20	4,000
5	SULAWESI II	1975	92.50	16.00	8.00	7.33	5,600	20	3,000
6	BETUAH	1977	92.00	16.00	8.00	7.33	5,600	20	3,000
7	SERAM	1981	92.00	16.00	8.00	7.30	6,000	20	3,000
8	HALMAHERA	1983	92.50	16.00	8.00	7.33	5,800	20	3,000
9	TIMOR	1980	95.00	18.40	7.00	3.00	5,300	20	2,000
10	BANDA	1982	71.10	14.00	4.90	4.05	2,130	14	1,000
11	NATUNA	1984	71.10	14.00	4.90	4.05	2,130	14	1,000

(2) Cutter Suction Dredgers

	Name of Ship	Year Built	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Maximum Draught (m)	Total Installed Power (HP / kW)	Dredging Depth (m)	Dredging Capacity (m^3/Hr)
1	BATANG ANAI	1994	93.80	18.50	7.00	5.0	12,966 kW	24.00	1,200
2	KAPUAS 30	1976	43.17	13.41	2.90	1.9	6,000	17.68	600

(3) Clamshell Dredgers

	Name of Ship	Year Built	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Grab Capacity	Total Installed Power (HP)	Dredging Depth (m)	Dredging Capacity (m^3/Hr)
1	DANAU LAUT TAWAR	1974	54.00	23.00	4.50	20 m^3	1,139	25	
2	BATUR	1984	28.00	13.00	2.60	5.5 m^3	455	20	300
3	RANAU	1984	28.00	13.00	2.60	5.5 m^3	455	20	300
4	POSO	1984	28.00	13.00	2.60	5.5 m^3	455	20	300
5	TONDANO	1984	28.00	13.00	2.60	5.5 m^3	455	20	300

Source: Website of PT (Persero) Pengerukan Indonesia, www.rukindo.co.id, October 2010.

Two hopper barges are to be deployed for transportation and dumping of the dredged material as the distance between the work site and dumping site is rather long.

-	Cutter Suction Dredger	equivalent to Batang Anai (refer to Table 5.1.6-1) Dredging depth: 24 m, Dredging capacity: 1,200 m^3/hour Base Port: Tanjung Priok
-	Anchor Boat	65 GT Class, 150 HP
-	Hopper Barge	Capacity: 2,000 m^3 x 2
-	Tug Boat	Pusher 200 GT Class (1,600 HP) x 2

Productivity of Dredging

Productivity of the proposed dredging system is examined for Tanjung Priok Port (North Kalibaru development; Phase I and II) as follows (refer to Table 5.1.6-2).

- Dredging Performance;
  The concentration of the dredged material is assumed as 40 % in the hopper. The dredged soil volume in the hopper barge is calculated as follows.
  2,000 m3 x 40 % = 800 m3 (Dredging Performance per cycle)
- Time to fill the capacity of 2,000 m3 hopper barge;
  Dredging capacity of the dredger is 1,200 m3/hour as above-mentioned. The time to fill the capacity of the barge is calculated as 0.67 hour (= 800/1,200).
- Sailing time (loaded) inside the harbor basin where port operations are busy;
  Sailing speed (loaded) is assumed as 3 knots;
  3 (miles) / 3 (knots) = 1.0 hours
- Sailing time (loaded) from the dredging site to the disposal site;
  Sailing speed (loaded) is assumed as 6 knots,
  14 (miles) / 6 (knots) = 2.33 hours
- Dumping time at the disposal site:
  0.25 hours (15 minutes)
- Sailing time (empty) from the disposal site to the dredging site
  Sailing speed (empty) is assumed as 8 knots;
  14 (miles) / 8 (knots) = 1.75 hours

  Working Cycle Time;
  0.67 + 1.0 + 2.33 + 0.25 + 1.75 +1.0 = 7.0 hours

  Dredging and disposal cycles per day;
  Effective Working Time is assumed as 21 hours/day
  21 (hours/day) / 7.0 (hours) = 3 cycles/day

  Productivity of dredging and disposal by two barges per day is calculated as follows;
  3 (cycles/day) x 800 (m3/barge) x 2 (barges) = 4,800 m3/day

  Working-day is assumed as 28 days per month;
  4,800 (m3/day) x 28 (days/month) = 134,400 m3/month

Productivity of the dredging work is also examined assuming the conditions of Cilamaya and Tangerang (see Table 5.1.6-3).

Over-dredging

It is empirically necessary to consider an over-dredging depth of 0.5 m in the dredging volume in order to achieve the design depth of channel and basin. As the total dredging area for the proposed dredging work is about 1,750,000 m2, the assumed over-dredging volume amounts to 875,000 m3 (0.5 m x 1,750,000 m2), which is equivalent to about 10 % of the total design volume of dredging.

Table 5.1.6-2 Productivity of Dredging Work (North Kalibaru)

Description	Calculation
Dredging Performance per cycle	800 m^3 per cycle
Working Cycle Time	5.0 hours
Time to fill 2,000 m^3 barge	0.67 hour; (2,000 x 40%)/1,200 m^3/hour
Sailing Time (inside the harbor)	2 x 1.0 hour (3 miles / speed: 3 knots)
Sailing Time (loaded; to dumping site)	2.33 hours (14 miles / speed: 6 knots)
Dumping Time	0.25 hour
Sailing Time (empty)	1.75 hours (14 miles / speed: 8 knots)
Effective Working Time per Day	21 hours/day
Dredging Cycle per Day	3.0 cycles/day
Production per Day	4,800 m^3/day (2 x 3 (cycles/day) x 800 m^3)
per month	130,000 m^3/month; 28 days/month

Table 5.1.6-3 Productivity of Dredging Work

(1) Cilamaya (Dumping site: 12 nautical miles distant)

Description	Calculation
Dredging Performance per cycle	800 m^3 per cycle
Working Cycle Time	5.0 hours
Time to fill 2,000 m^3 barge	0.67 hour; (2,000 x 40%)/1,200 m^3/hour
Sailing Time (loaded; to dumping site)	2.0 hours (12 miles / speed: 6 knots)
Dumping Time	0.25 hour
Sailing Time (empty)	1.5 hours (12 miles / speed: 8 knots)
Effective Working Time per Day	21 hours/day
Dredging Cycle per Day	4.75 cycles/day (4.42 hours/cycle)
Production per Day	7,500 m^3/day (2 x 4.7 (cycles/day) x 800 m^3)
per month	210,000 m^3/month; 28 days/month

(2) Tangerang (Dumping site: 10 nautical miles distant)

Description	Calculation
Dredging Performance per cycle	800 m^3 per cycle
Working Cycle Time	5.0 hours
Time to fill 2,000 m^3 barge	0.67 hour; (2,000 x 40%)/1,200 m^3/hour
Sailing Time (loaded; to dumping site)	1.67 hours (10 miles / speed: 6 knots)
Dumping Time	0.25 hour
Sailing Time (empty)	1.25 hours (10 miles / speed: 8 knots)
Effective Working Time per Day	21 hours/day
Dredging Cycle per Day	5.5 cycles/day (3.84 hours/cycle)
Production per Day	8,800 m^3/day (2 x 5.5 (cycles/day) x 800 m^3)
per month	240,000 m^3/month; 28 days/month

(2) Reclamation and Soil Improvement

1) Procurement of Reclamation Materials

A number of sources for procurement of reclamation materials have been examined carefully not only in the area of West Java but also in neighboring regions. Sea sand mining has been strictly regulated on the coast of Tangerang and West Java as part of beach erosion control and environmental conservation.

Based on the field surveys by the JICA Study Team, Bojonegara (Banten Province, around 100km from Jakarta), Lampung (South Sumatra, around 200 km from Jakarta), and Bangka and Belitung Islands (Bangka-Belitung Province, around 350 km from Jakarta) are named as the candidate sources.

Price of reclamation material is largely affected by transportation cost which depends on the distance between the source and the construction site. Average prices were advised as for mountain sand from Bojonegara as “20,000 Rp/ m^3 + transportation: 85,000 Rp/ m^3”, and as for procurement from Bangka / belitung Islands as “170,000 Rp/ m^3 including Transportation cost”.

The source in the Bojonegra area closest to Jakarta among the candidate sites is assumed for procurement of reclamation material. There are many local quarries (rock and stone providers) and mountain sand providers in and around Bojonegra, where the required quality will be satisfied for the reclamation works planned in the projects of North Kalibaru, Cilamaya and Tangerang.

It is observed that the providing capacity of a provider is on the level of 5,000 m3 per day if equipped with belt conveyer system from mining point of the sand to the shipping point, and 20-ton class wheel loader and 40-ton class bulldozer with rippers and a 50-ton class dump truck desirable to be added as well. In order to secure safe and constant procurement of the material, two or three providers of this scale are necessary.

The providing capacities of existing providers in Bojonegara are considerably smaller than the estimate required volume mentioned above.

2) Transportation of Reclamation Materials

Considering the environment of the development sites and the source area of reclamation material, transportation by floating barge is recommendable for smooth procurement of the material. Due to the following three main reasons, sea transport is selected over land transport.

The first is, in case of on land transportation by dump trucks, heavy traffic congestion in and around Jakarta city will directly affect the construction schedule. The second is, a dump truck can carry only 10 tons of sand, which will lower work efficiency as compared to sea transport. The third is, dump truck transportation of a large volume material requires a large stockyard with a jetty for transshipment to provide the material to the placing point on the sea. Considering the above aspects, sea transportation of reclamation material by floating barges is effective for the project.

In order to secure safe and constant sea transportation, and considering the distance from Bojonegara to the terminal construction sites on the north coast of West Java, the 2,000 - 5,000 tons capacity of a floating barge and a towing tug of the 1,500 - 2,000 HP class will be required..

For the Cilamaya project, a candidate source of reclamation material is located at Cipatat, around 25 km northwest of Bandung, where sufficient quantity and satisfactory quality of reclamation material for the project can be expected.

The quarry site is located inland 75km southwest from Cilamaya, and on land transportation by dump trucks will be applied in this case. The existing road condition of the route except toll highway is narrow and poor for heavy loaded vehicles, therefore construction of a temporary working road should be considered in the construction schedule connecting the existing highway junction with the development site of the Cilamaya terminal.

3) Recycling of Dredged Material

Considering the tight construction schedule and the large reclamation volume, recycling of dredged material of the channel and basin should be affirmatively examined.

As the result of Subsoil Conditions Survey in the development areas, the upper layers of the seabed consist of clay and silt with N value 0 – 2. The average depth of these very soft layers is from 8 to 10 meters in Tanjung Priok.

Although those soft materials of fine sediment components (clay and silt) are not suitable for use directly in reclamation work without treatment, there is a reason to re-consider recycling of those soft material obtained by dredging works for reclamation when procurement of mountain sand of good quality is predicted difficult (due to the limitation of resources or productivity at the quarry).

A possible way to make use of fine material from reclamation work is by applying the method of cement soil improvement. In case of using fluid mud, there are two methods of cement soil improvement. The first is a conventional method, in which cement soil improvement is done after reclamation by a pump dredger.

The second is a new technology invented in Japan called “pipe-mixing method”. The base principle of the method is that dredged soft material is mixed with cement mortar and treated in the process of conveying in dredging pipe. In case of using this “pipe-mixing method”, the special purpose working barge and related devices for the system must be mobilized from Japan.

The procurement cost of this system is considerably more expensive than conventional soil improvement method, i.e., vertical drain method, PVD, etc.

A preliminary cost estimate is carried out for applying “Pipe-mixing Method” for treatment of soft material in Jakarta Bay and to recycle the dredged material. Consequently the cost will range from 200,000 – 400,000 Rupiah for a cubic meter of treatment of soil. Thus by making use of recycled soft material, the cost will be double that of using mountain sand from quarries in the Bojonegara area.

Although applying the “pipe-mixing method” has a big merit in which the work period for reclamation can be shortened, its disadvantages are the higher construction cost and the inability to apply the recycling method.

4) Reclamation Works

Planned reclamation areas for the projects are quite large (i.e., North Kalibaru Project Phase I: 77 ha, Phase II: 129 ha, and Phase III: 190 ha), Hence enclosure revetments should be constructed in advance of land reclamation. This is the method called “Section Landfill method” and is applied for the North Kalibaru Project. Assuming required reclamation volume as 10,000～15,000 m3 per day, one segmented area can be planned to have around 25 ha. To divide the reclamation area into sections, partition dykes are constructed with rubble stone mound structure.

According to the subsoil conditions survey in the offshore area of North Kalibaru, the very soft layers with SPT-N value less than 10 has a 10 meters thickness from the seabed. The vertical drain method (PVD = Plastic Vertical Drain for example with 1 meter interval) will be applied in the reclamation area to accelerate consolidation of the soft layer and to acquire required foundation strength. Immediately after this work, pre-loading of surcharge soil method is applied using imported mountain sand of good quality on the ground of improved soil by PVD.

Based on experience in placing reclamation material in the water area of Tanjung Priok Port, ground is expected to settle with 3 meters thickness by consolidation of the soft layers and resulting subsidence. Therefore 3 meters thickness of mountain sand will be taken into consideration in the estimate of reclamation volume.

5) Soil Improvement

Vertical Drain Method

The sand replacement method was originally designed for the foundation of breakwater. However, sand replacement, which is to remove surface layers of soft material and refill with good quality sand, does not seem to be applicable for the following main reasons. The existing soft layer has thickness of more than 5 m, and the dredging volume of such soft soil is too much to remove. Considering such a huge dredging volume, it is not an appropriate construction method from the financial and work management perspectives.

On the other hand, based on the soil characteristics, combination of Preloading and Vertical Drain methods will be appropriate and effective for the compaction process of the poor soil layer and for accelerating the consolidation up to 90%.

Sand Compaction / Deep Soil Mixing

For the construction of breakwater and revetment, Sand Compaction Pile method or Deep Soil Mixing method on the existing sea bed should be examined. In the case of applying Sand Compaction method, a huge amount of fine sand is required. However, considering environmental aspect and the surroundings in/ around the North Kalibaru area, it might be difficult to acquire such volume and quality of sand.

In the case of Deep Soil Mixing method, cement as main material seems to be easily procured and work quality seems to be controlled easier. The residual settlement is serenely generated in case that improvement is done by bearing layer. However, it must be noted that the cost of the method is relatively higher and that such an advanced method has never been applied before in Indonesia.

Compaction/Jet Grouting

As another option, Compaction/Jet Grouting method can be considered to increase the rate of consolidation and reduce the total amount of settlement.

In terms of reuse of dredged soft material as reclamation material, Pipe Mixing method, which is to improve soft soil characteristics by adding sprayed cement during the process of soil conveying into dredging pipe, seem to be effective. Cemented soil is relatively lightweight and it contributes to decreasing overburden loading by reclaimed.

Considering the advantages/disadvantages of the above applicable methods, combination of PVD with preloading is considered more practical among other methods; moreover, this method has been employed in Indonesia in the past.

(3) Quay Wall Construction

The structure of quay wall of the container terminal is designed as steel pipe piles foundation (D: 900 - 1,200 mm, L: 28 – 40 m) with upper RC (reinforced concrete) deck. The whole Quay Wall is comprised of divided blocks with each unit block being 30 m x 35 m. Approximate estimated concrete volume is 500 m^3 per block.

1) Piling Works

The foundation of the quay walls is planned as vertical steel pipe pile structure (D: 1,200 mm, L: 40 m for North Kalibaru and Tangerang project; D: 900 mm, L: 28m for Cilamaya project. The steel pipe piles will be procured domestically from Indonesian local manufacturers.

The pile foundation will be constructed with battering method of piles by pile hammer. Considering the pile dimensions, the length and the sub soil conditions in each site, as long as using natural drop method by diesel hammer or hydraulic hammer, it is assumed that the ram weight of 8-ton hammer will be needed. The hammer is equipped to an appropriate capacity of piling barge. The following figure presents an image of the piling barge with solid-set pilling tower.

2) Concrete Works on Upper Deck

The upper part of the quay wall is planned as In-situ RC structure. After completion of the piling works, temporary scaffolding at the bottom to support the loads of upper RC structure will be fabricated.

Fresh ready-mixed concrete for the projects will be considered for hot weather concrete in which daily average temperature is 25ºC or higher. The concrete for North Kalibaru project will be procured from several concrete plants located in the Jakarta area. Considering heavy traffic congestion through the Jakarta metropolitan region during the daytime, concrete should be transported at night time. To decrease the risk mentioned above, it is recommended that the contractor set up a concrete plant facility at each site.

Concrete Placing will be carried out with concrete pump(s) having appropriate pressure and working range. Considering planar dimensions of a unit block as 30 m x 35 m, concrete volume of a unit block and concrete leveling and finishing speed, the minimum requirement of a concrete pump truck should be 22-ton class (50 – 120 m3/hour, piston type) equipped with minimum 40 m working range including extension hose.

(4) Breakwater and Seawall Construction

Breakwater will be constructed to provide shelter not only to the port basin but also the working area of the construction from wave actions particularly during stormy conditions and northwest monsoon season. The construction schedule of those protective facilities should be placed as the forerunner of the implementation schedule.

1) Foundation and Soil Improvement

The foundation of breakwater was originally designed as sand replacement method. Considering the tight construction schedule and high price of good quality sand, it is recommended that combined use of Vertical Drain Method and Pre-loading of surcharge load (mountain sand) at the foundation be adopted instead of sand replacement method aiming at compaction of the layers of soft material and enhancement of the shear strength.

The Vertical Drain Method will be applied up to the depth of the layers where SPT-N value is less than 10, and placement of mountain sand (surcharge load) follows to accelerate consolidation and compaction of the soft layers.

The basic structure of breakwater is planned as rubble-mound type and wave dissipating concrete blocks (6.3-ton, 2-ton types of Tetrapod, for example) and concrete blocks (0.9 - 0.7m cube) will be used for the armour layers.

In the case of North Kalibaru Project, the materials from the existing breakwater (planned to be demolished or relocated) will be recycled for the construction of the new breakwater and revetment for the purposes of saving construction cost and reducing environmental risks by dumping.

2) Rubble Stone Mound

Rubble stone will be procured from several sources mainly around the Bojonegara area and stones will be transported by floating barge. As the first step of rubble mound construction, the rubble stones will be loaded on the flat barge by wheel loader (20-ton class) and excavator (2 m^3 class) to gain assumed daily-required volume of 4,000 m^3.

According to the Consultant's field studies, existing providers around the Bojonegara area work on a relatively small scale, that is, average capacity of their own equipment is the level of excavator (1.2 m^3 class) and wheel loader (2.2 m^3 class). Hence, in order to gain the required volume, material should be procured from a number of sources or new additional investment to enhance the equipment capacity will be required.

The barges should be 2,000 – 5,000-ton class and be special armed type for carrying stones. The barge will be towed by tugboat(s) (1,500 HP per ship). The stones will be placed by clamshell (3 m^3) without disturbing filled sand. After the placement of stones, the rubble mound will be formed by excavator (2 m^3 class) along with designed profile under indication by skilled divers.

3) Wave Dissipating Concrete Blocks and Cube Blocks

Fabrication of Blocks

Fabrication of concrete blocks for the projects will be executed on land in an open temporary yard with jetties for loading (fabricated blocks) and unloading (materials for fabrication). For North Kalibaru projects, two potential candidate yards will be available in Marunda area behind Marunda Harbor located within 10 km from Tanjung Priok Port.

The first candidate is in a new commercial development area named Marunda Center which accommodates fourteen private companies as of now. There is an open yard (the area is: 600 m x 150 m + 300 m x 150 m) with reclaimed jetty of 300 m. The other is newly reclaimed land (the area is: 300 m x 1,100 m) by KBN with long berths approximately 1,100 m in length with -3 m depth. Presently the place is free according to KBN, but it will be developed as new container stock yard in near future. The access road from Tanjung Priok to Marunda area is only one way and constantly congested by container trailers because there are many container stock yards along the road.

Ready-mixed Concrete

There are many concrete mixing plants commercially operated in the Jakarta area. Supply capacity is approximately 300 m^3 per day on average by each plant and generally their quality control is stable. Fresh ready-mixed concrete for each project should be considered as hot weather concrete that is used under the condition of daily average temperature as 25ºC or higher.

To avoid potential risks accompanying with procurement of ready-mixed concrete from Jakarta area, it is recommended to set up a concrete mixing plant in this yard. In this case, the yard area should be decided considering not only the space of block fabrication but also concrete mixing plant in order for trucks to access the area safely. In addition, for the purpose of prevention of cement and sand dust pollution especially during the northwest monsoon season, dust prevention wall that does not interfere with the commercial activities surrounding the site should be installed.

Installation

The installation of the blocks will be in two steps. In the first step, the blocks will be installed from the bottom to the top of the rubble mound to keep space for constructing upper in-situ crown concrete, that is, after completion of crown concrete. In the second step, the balanced blocks will be installed. Considering the weight of one wave dissipating block (6.3-ton or 2-ton), the installation equipment will be a crane barge (80~50-ton class crane outfitted properly on 1,000-ton ~ 1,500-ton class barge).

4) Crown Concrete

Crown concrete is placed by in-situ method. Considering the sectional shape, the placing of concrete will be line splitting divided into two times. Expansion joint will be installed usually every 10 m in longitudinal direction.

Ready mix concrete transported by concrete agitating trucks will be carried to the placing point on the sea by using flat barge. Placing concrete will be done by using crane barge (50-ton class) equipped with hopper (concrete skip, 1 m^3). The hopper should be opened gently so as not to damage the assembled formworks and supporters.

(5) Revetment

1) Foundation and Soil Improvement

The revetment structure is rubble-mound type with coping concrete, except the north revetment of North Kalibaru site that has steel sheet piles (L=25m) foundation behind of rubble mound and under coping concrete.

Soil improvement works by Vertical Drain Method will be applied at the foundation aiming at compaction of the layers of soft material and enhancement of the shear strength. Soil improvement is designed up to the depth of the layers where SPT-N value is less than 10, and placement of mountain sand (surcharge load) follows to accelerate consolidation and compaction of the soft layers.

2) Rubble mound

Rubble stones of revetment for each project will be procured from Bojonegara by barge. The methodology of rubble mound construction is basically the same as breakwater construction. After rubble mound construction, geo-textile sheets, which prevent diffluence of reclamation material, should be carefully laid.

3) Armor Stone

Armor stones of revetment for all projects as well are assumed to be procured mainly from Bojonegara. The main issues concerning armour materials are; 1) weight of a piece and 2) specific gravity of stone. Installation of armour stones is executed by crane (50-ton class) from reclaimed land or by crane barge (50-ton class) on the sea.

4) Coping Concrete

Ready-mixed concrete suitable for hot weather is procured from concrete plants nearby each project site considering mixing capacity and transportation time. Material of Formworks is basically woody comprised plywood, 4 x 4, and 2 x 4 square timber. Concrete placing will be done by using crane barge (50-ton class) equipped with hopper. Concrete blocks will be fabricated in temporary fabrication yard prepared for each project.

5.1.7 Maintenance Dredging at Tanjung Priok Port

(1) Sedimentation in Tanjung Priok Port

Sedimentation at Tanjung Priok Port and maintenance dredging of the navigation channels and harbor basins have been studied in the previous JICA Study (2002 – 2003) as well. Reviews on the previous studies and the findings of the latest 5 years and its analysis are presented in this section.

1) Port Location

Tanjung Priok Port is located on the northeastern coastline at the outskirts of DKI Jakarta. The surrounding area of the port is flat with the elevation of approximately 2 m (MSL), and the coastline runs nearly in the east-west direction. According to the navigation chart of the Jakarta Bay area, the seabed slope is about 1/500 and the depth contour lines are seen parallel with the coastline of the bay.

Many rivers and drainage canals run in the south-north direction through the flat terrain surrounding the port. The following three rivers or drainage canals flow into the waters of Tanjung Priok Port.

- Kali Sunter Baru flows into Pelabuhan Minyak (Pertamina) at the eastern end of the port
- Terusan Lagoa flows into the water area between JICT and TPK Koja
- Kali Ancor flows into Pelabuhan Nusantara at the western end of the port

Figure 5.1.7-1 Kali Sunter Baru (Left) and Terusan Lagoa (Right)

The early facilities of Tanjung Priok Port were constructed at the end of the 19th Century and the said Port was constructed in the suburbs of Batavia City, surrounded only by paddy fields and swampy areas. The areas surrounding Tanjung Priok Port have been rapidly urbanized through the 1950s to 1980s. Thus the harbor basins of Tanjung Priok Port accept rain water drainage from the urban areas of Jakarta including solid wastes.

2) Sedimentation in the Water Areas of Tanjung Priok Port

The sounding surveys for the purpose of Pre- and Post-Dredging of the harbor basins and channels have been carried out several times a year by PELINDO II (Cabang Tanjung Priok). Those existing sounding data (1991 - 2001) were analyzed in the previous JICA Study to study the seabed changes in the water areas of Tanjung Priok Port. The following features were verified by the study.

- In the west access channel to the Tanjung Priok Port (Ambang Luar Barat), the seabed had risen about +0.5 m per year on average at the channel center. The seabed rise presents smaller with respect to the distance from the entrance of the harbor (Pintu Masuk).
- The outlet area of Kali Sunter Baru at Pelabuhan Minyak presented the highest value of seabed rise, which was evaluated at about +7.0 m per year. The second highest was about +2.0 m per year at the middle of Pertamina berth.
- The seabed rise at the harbor basins Pelabuhan I, II and III was evaluated very small and estimated at less than +10 cm per year.
- While the seabed rises at the harbor basins and the water areas inside the breakwater were evaluated higher, it was evaluated lower at the channel outside the breakwater. The seabed rises along the approach channel (Ambang Luar Barat; around 3 km) were evaluated 0.1 m to 0.5 m per year.

The main source of the seabed rise at the water areas inside the breakwater is considered due to sedimentation of the materials carried by the drainage canals such as Kali Sunter Baru, Terusan Lagoa and Kali Japat, into the harbor basins of Tanjung Priok.(2) Maintenance Dredging

Maintenance dredging in Tanjung Priok Port has been carried out regularly and maintained at the designed depth at major channels and basins. The summary of maintenance dredging in the channels and harbor basins is presented in Figure 5.1.7-2 and Table 5.1.7-3.

(2) Summary of Maintenance Dredging Volume at Tanjung Priok Port

The records of maintenance dredging volume are presented in the following table (Table 5.1.7-1) for the latest 5-year period (2005 – 2009).

Table 5.1.7-1 Average Annual Dredging Volume for 2005 - 2009

Year	Dredging at Channels	Dredging at Harbor Basins	Total Contract Volume
2005	300,000	305,592	605,592
2006	474,455	156,955	631,410
2007	430,231	37,618	467,849
2008	553,165	247,521	800,686
2009	241,942	117,958	359,900
Average	**399,959**	**173,129**	**573,087**

(Source: PELINDO II, Cabang Tanjung Priok, Technical Division; Unit: m^3/year)

According to the average of the maintenance dredging at each part of channel and harbour basin in Tanjung Priok Port, the following findings can be noted.

1) Dredging in Channels

The annual volume is around 400,000 m^3/year in the navigation channels, and the east – west channel from the eastern innermost of the port (DKP) to the west entrance (Alur DKP s/d Pintu Masuk; depth: -14 m, length: 3,530 m) shows the largest maintenance dredging volume, accounting for over 50 % of the volume (181,000 m3/year + around 55,000 m3/year at Dermaga TPK Koja and Dermaga JICT).

The access channel to the west entrance of the port (Ambang Luar Barat; -14 m, 3 km) accounts for around 25 % of the volume (105,000 m^3/year).

2) Dredging in Harbor Basins

As for the harbor basins, the annual volume is around 180,000 m^3/year, and the basin Pelabuhan Mynyak accounts for the most portion of the volume (113,000 m^3/year). The smaller basins of Pelabuhan I, II and III account for around 25 % of the volume (45,000 m3/year).

The sedimentation in the harbor basins of Tanjung Priok is largely affected by the materials transported by the drainage canals such as Kali Sunter Baru, Terusan Lagoa and Kali Japat, flowing into the harbor of Tanjung Priok Port. That is the reason why the sedimentation volume in the areas of Pelabuhan Minyak and Alur DKP s/d Masuk Barat shows larger figures.

Meanwhile, as for the channel inside and outside the east entrance, no maintenance dredging has been executed in the last 20 years. This section of the channel is neither maintained nor used by any outgoing or entering vessels except some small boats.

As mentioned and discussed in the previous sub-section, the major reason of the maintenance dredging in the port area of Tanjung Priok is due to sedimentation of the materials carried by the drainage canals such as Kali Sunter Baru, Terusan Lagoa and Kali Japat, into the harbor basins of Tanjung Priok.

The sedimentation in the approach channel (outside the breakwater) due to wave actions and longshore current can be considered not large in Jakarta Bay and the surrounding area of Tanjung Priok, which accounts for around 20 % of the total volume of maintenance dredging at Tanjung Priok Port (Amabng Luar Barat 2000 – 2009: 105,000 m3/year, and Total Contract Volume 2005 – 2009: 575,000 m3/year).

Table 5.1.7-2 presents the characteristic factor for the average volume of yearly sedimentation as the parameter of horizontal projection area of the channel or basin.

The sedimentation in the approach channel (outside the breakwater) due to wave actions and longshore current can be considered not large in Jakarta Bay. The average sedimentation per year is evaluated as <u>0.22 m^3/year/m^2</u>.

As for the harbor basin (inside the breakwater), where not largely affected by the river effluence and materials, the average sedimentation per year is evaluated as 0.15 m^3/year/m^2.

Table 5.1.7-2 Maintenance Dredging Volume at Tanjung Priok Port (Average 2000 - 2009)

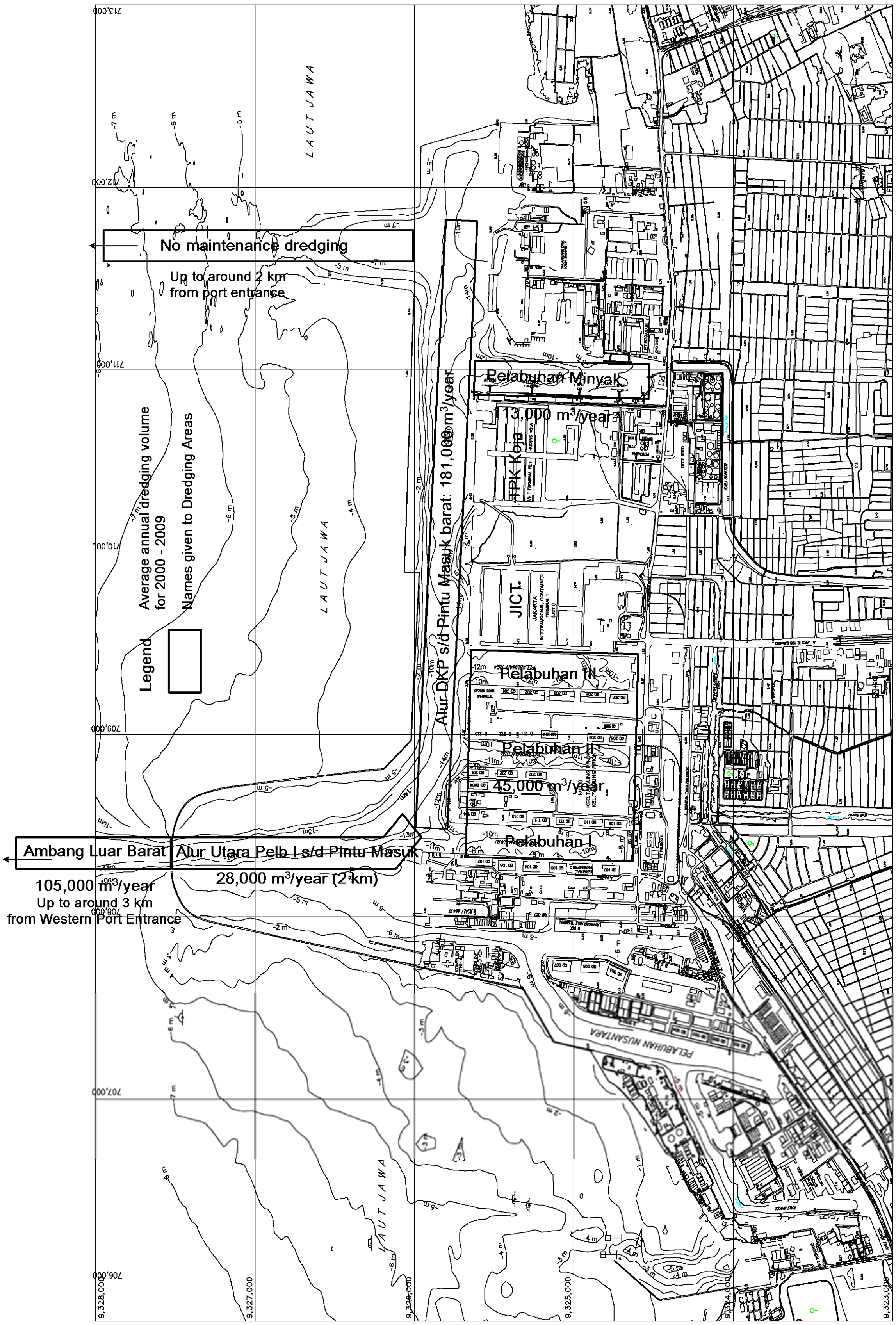
Source: JICA Study Team based on data from PELINDO II (Cabang Tanjung Priok)

Division of Channel / Basin	Depth (m) Width (m) Length (m) Side Slope	A: Maintenance Dredging Volume (2000 - 2009)	B: Horizontal Area of Channel / Basin	Average Sedimentation per Year (A / B)
Alur DKP s/d Pintu Masuk Barat	-14 m 100 m 3,530 m 1:4.0	181,000 (m^3/year)	353,000 m^2	0.51 m^3/year/m^2
Alur Utara Pelabuhan I s/d Pintu Masuk	-14 m 100 m 1,925 m 1:4.0	28,000 (m^3/year)	192,500 m^2	0.15 m^3/year/m^2
Ambang Luar Barat	-14 m 100~150 m 3,000 m 1:4.0	105,000 (m^3/year)	483,000 m^2	0.22 m^3/year/m^2

(3) Dumping Site of Dredged Soils

The dumping site of the dredged material from Tanjung Priok Port has been designated in the water area called Muara Gembong (refer to Figure 5.1.6-1).

A new dumping site is designated in the water area offshore Karawang around 30 meters in water depth by the recent instruction from ADPEL (Adpel Utama Tanjung Priok, 10th February 2010). Distance between the new dumping site and Tanjung Priok Port is around 26 km (14 nautical miles).



Source: JICA Study Team

Figure 5.1.7-2 Summary of Maintenance Dredging Volume at Tanjung Priok Terminal (average for 2000-2009)

Table 5.1.7-3 Summary of Maintenance Dredging Volume at Tanjung Priok Port (1991 – 2009)

Source: PELINDO II (Technical Division, Cabang Tanjung Priok) (Unit: m^3/year)

		Navigation Channels				Harbor Basins						
		No.1	No.2	No.3	No.4	No.1	No.2	No.3	No.4	No.5	No.6	No.7
Name		Alur DKP s/d Pintu Masuk Barat	Ambang Luar Barat	Alur Utara Pelb I s/d Pintu Masuk	Pelabuhan Minyak I & II	Kolam Pelabuhan I	Kolam Pelabuhan II	Kolam Pelabuhan III	Pelabuhan Nusantara I & II	Kolam Kali Japat	Dermaga TPK Koja	Dermaga JICT
Dimensions	Depth (m)	-14.0	-14.0	-14.0	-12.0	-8.0	-9.0	-10.0	-6.0	-5.0	-14.0	-12.0
	Width (m)	100	100 / 150		50	170	140	180	150	80	175.0	90
	Length (m)	3,530	3,000	1,925	1,145	1,285	1,035	1,050	1,600	1,520	430	1,050
	Side Slope	1:4.0	1:4.0	1:4.0	1:4.0					1:2.0		
Years	1991	41,252	-		125,257	-	-	-	11,294	45,718	-	-
	1992	113,399	-		31,989	-	4,769	-	148,480	-	-	-
	1993	128,000	-		95,544	-	40,483	-	-	-	-	-
	1994	-	118,601		91,719	-	9,485	-	-	-	-	-
	1995	238,988	-		102,241	-	-	-	92,580	-	-	-
	1996	374,853	-		83,461	-	-	-	-	-	-	-
	1997	114,969	109,620		143,349	-	3,400	7,599	93,580	-	-	-
	1998	-	-		147,418	-	73,774	-	-	28,773	-	-
	1999	-	-		95,157	-	80,011	-	96,725	-	-	-
	2000	460,703	-		185,354	-	3,091	-	-	-	99,785	-
	2001	26,144	412,811		100,000	-	67,670	19,419	37,866	-	62,096	19,419
	2002	285,766	-	-	172,479		55,620		41,106	-	45,871	47,855
	2003	218,341	-	-	118,085		47,071		31,381	22,664	38,354	19,177
	2004	143,668	-	-	78,401		36,611		24,407	-	25,223	6,974
	2005	130,000	100,000	-	100,000	27,894	27,894	24,407	6,974	20,014	30,056	40,446
	2006	145,967	196,683	77,688	54,117	5,357	19,044	-	14,616	-	21,397	
	2007	177,543	117,058	15,608	157,640	-	-	-	-	-	-	-
	2008	163,980	193,551	125,098	70,536	17,393	18,371	34,180	11,563	-	57,139	
	2009	61,539	29,172	59,624	91,608	9,447	8,406	26,549	9,551	-	24,404	11,133
Average	1991 - 1999	112,385	25,358	0	101,793		24,391		49,184	8,277	0	0
	2000 - 2009	181,365	104,928	27,802	112,822		44,842		17,746	4,268	54,933	
	Whole Period	148,690	67,237	14,633	107,598		34,617		32,638	6,167	-	

5.1.8 Preliminary Cost Estimate

(1) Construction Procurement

1) Construction Materials

Almost all the construction materials are produced domestically in Indonesia and can be procured in the market. The prices are relatively stable in the recent years.

Cement

There are nine major Indonesian cement manufacturers providing various types of cement to the Indonesian construction market. The Indonesian home-produced cement is said to be sufficiently stable in quality and giving the required strength of the design mixture.

Concrete Products

There are a number of providers of ready-mixed concrete and manufacturers of concrete products in Indonesia such as centrifugal reinforced concrete (RC) pipes, pre-stressed concrete (PC) piles and PC beams.

Steel Products

Steel and steel products for construction material are domestically produced in Indonesia, except for the special item such as steel sheet piles, which are imported from Japan or Europe.

Soil for Reclamation

Tens of millions m3 of reclamation is assumed in the future development in Tanjung Priok and also tens of millions m3 of reclamation is assumed in Cilamaya and Tangerang.

Mountain sand from Bangka Island and Belitung Island (South Sumatra) was used as the filling materials for the reclamation works in the Koja Terminal expansion and JICT. Sea transportation from the Banten area is considered in this Study.

As for soil materials for embankment of road way and rail way, mountain sand and red soil (Tanah Merah) will be procured form the quarries in Bogor and Bandung areas.

Aggregates

There are many quarries located in the Banten area, although it is said that there are few quarries where concrete aggregate of good quality is available.

The mining from quarry, riverbed and/or seabed is under the regulation of Ministry of Mining of the Government of Indonesia.

2) Construction Equipment

There exists a well-developed leasing market of construction equipment in Indonesia. According to hearings with major construction companies, most of the general-purpose construction equipment (such as bulldozers, backhoes, shovel loaders, concrete mixers, etc.) mobilized in the large-scale construction of public works can be procured from the leasing market.

In the case of long-term construction period over about three years, it would be advisable for the contractor to purchase and possess his own construction equipment.

(2) Capability of Construction Companies

The fields of construction where the Indonesian local companies have experience are mainly building and housing development, road construction, water supply and sewerage construction, irrigation, etc. They also have relatively sufficient experience in marine construction in Indonesia**.**

The following are the major state-owned construction companies in Indonesia, which have sufficient experience of public works construction and port and harbor development.

1) PT. Hutama Karya
2) PT. PP (Pembangunan Perumahan)
3) PT. Waskita Karya
4) PT. Wijaya Karya
5) PT. Adhi Karya
6) PT. Nindya Karya

Other than the above-mentioned major six companies, several numbers of medium-scale companies and hundreds of small-scale companies are running their businesses in the Indonesian construction market.

Two Indonesian companies and several Japanese-based companies were interviewed by the Study Team visit for interview to learn about local construction market, procurement of construction materials/equipment/labour, etc.

(3) Basis of Construction Cost

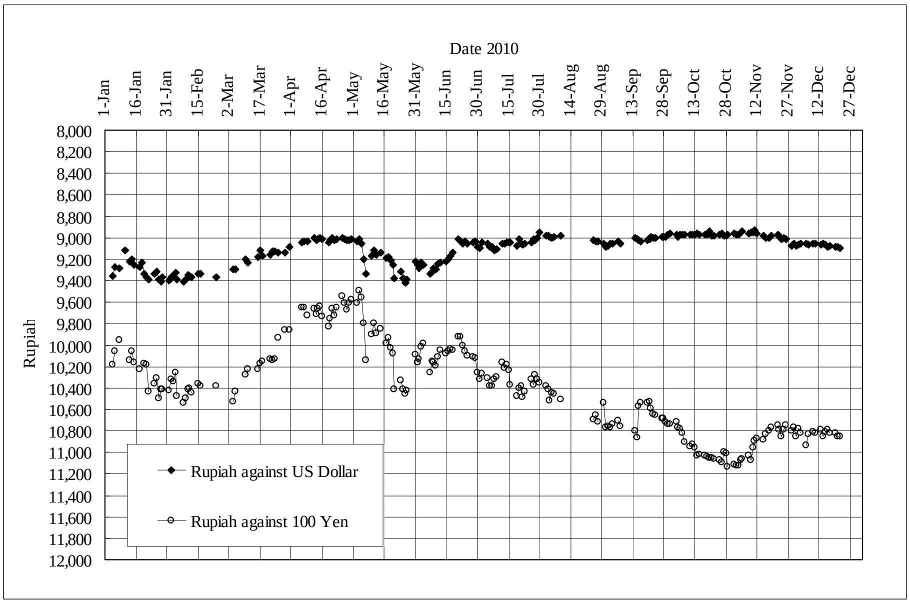
1) Unit price of labour / material / equipment

Unit price of each element such as labour, construction material and construction equipment are to be determined on the basis of the information collected in the field study (Jakarta and Bandung, July and October 2010). The unit prices collected from the major construction companies are summarized in Table 5.1.8-1 and Table 5.1.8-2.

2) Exchange Rate of Currencies

The basic prices are as of July and October 2010 and the foreign exchange rate is given as follows considering the current trend in the end of 2010. Reference is made to Table 5.1.8-1 for the recorded change of Rupiah rate against US Dollar and Japanese Yen.

1 USD = 9,000 Rupiah, 100 Yen = 11,000 Rupiah



Source: JICA Study Team

Figure 5.1.8-1 Exchange Rate of Rupiah against US Dollar and Japanese Yen (2010)

3) Foreign and Local Portion in Prices

Each unit price was split into foreign currency and local currency portions, both indicated in Rupiah, estimated in the following classifications;

The foreign currency component consists of:

- Imported construction materials
- Foreign components of depreciation and operation/maintenance cost for construction equipment and plant
- Foreign component of domestic materials
- Salaries and costs of foreign personnel

The local currency component consists of:

- Local construction materials
- Local components of depreciation and operation /maintenance cost for construction equipment and plant
- Salaries and costs of local personnel
- Import duty on imported materials
- Indonesian taxes

Table 5.1.8-1 Unit Prices of Construction Labour and Material in West Java Area

No.	Item	Time Unit	Average (Rupiah)
L- 1	Supervisor	day	205,000
L- 2	Foreman	day	155,000
L- 3	Group Leader	day	146,000
L- 4	Skilled Labour	day	139,000
L- 5	Common Labour	day	112,000
L- 6	Scaffolding Man	day	102,000
L- 7	Carpenter	day	135,000
L- 8	Mechanic	day	168,000
L- 9	Electrician	day	170,000
L- 10	Welder	day	176,000
L- 11	Steel Fixer	day	126,000
L- 12	Mason	day	133,000
L- 13	Painter	day	135,000
L- 14	Plumber	day	135,000
L- 15	Surveyor	day	194,000
L- 16	Assistant Surveyor	day	126,000
L- 17	Operator (heavy)	day	182,000
L- 18	Operator (light)	day	140,000
L- 19	Truck Driver	day	137,000
L- 20	Captain (Tug Boat)	day	556,000
L- 21	Crew	day	280,000
L- 22	Scuba Diver	day	435,000
L- 23	Engineer (Expatriate)	month	45,200,000
L- 24	Engineer (Local)	month	7,500,000
L- 25	Assistant Engineer	month	5,900,000
L- 26	Supervisor	month	4,300,000
L- 27	Secretary	month	3,900,000
L- 28	Assistant Secretary	month	3,000,000
L- 29	Typist	month	3,000,000
L- 30	Guardsman	month	2,800,000
L- 31	Janitor	month	2,600,000

No.	Item	Unit	Average (Rupiah)
M- 1	Steel Bar (Deformed Bar)	kg	8,000
M- 2	Structural Steel	kg	10,000
M- 3	Steel Sheet Pile; SP-II, III, IV	kg	10,500
M- 4	Steel Pipe Pile	kg	12,000
M- 5	RC Spun Pile; dia 500~600 mm	m	541,000
M- 6	Ready-mixed Concrete		
	Strength: 125 kg/cm^2	m^3	549,000
	Strength:175 kg/cm^2	m^3	578,000
	Strength: 225 kg/cm^2	m^3	617,000
	Strength: 275 kg/cm^2	m^3	653,000
	Strength: 300 kg/cm^2	m^3	662,000
M- 7	Portland Cement (50 kg sack)	50 kg	61,000
M- 8	Aspahlt Imported	kg	7,000
M- 9	Fine Aggregate	m^3	200,000
M- 10	Sea Sand	m^3	155,000
M- 11	River Sand	m^3	194,000
M- 12	Red Soil (Tanah Merah)	m^3	60,000
M- 13	Coarse Aggregate	m^3	200,000
M- 14	Crushed Stone; 1~2 cm	m^3	174,000
M- 15	Crushed Stone; 2~3 cm	m^3	186,000
M- 16	Macadum; 5~7 cm	m^3	153,000
M- 17	Cobble Stone	m^3	190,000
M- 18	Rock for Rubble Mound	m^3	164,000
M- 19	Gasoline (Bensin Premium)	litre	5,900
M- 20	Diesel Oil (Minyak Solar)	litre	7,000
M- 21	Kerosin (Minyak Tanah)	litre	10,000
M- 22	Geotextile Filter Sheet	m^2	16,000
M- 23	Asphalt Concrete Mix	ton	1,500,000

Source: JICA Study Team

Table 5.1.8-2 Unit Leasing Prices of Construction Equipment in West Java Area

(Price Unit in Rupiah)		Company A			Company B			Company C			Company D		
No.	Item	Power / Specification	Price* (Rupiah)	Unit	Power / Specification	Price (Rupiah)	Unit	Power / Specification	Price (Rupiah)	Unit**	Power / Specification	Price (Rupiah)	Unit
E- 1	Bulldozer	160 HP	358,800	hour	21-ton class	135,000	hour	150 HP	320,000	hour			
	Bulldozer	200 HP	450,000	hour	32-ton class	150,000	hour	200 HP	330,000	hour			
	Bulldozer	320 HP	717,600	hour			hour						
	Bulldozer	425 HP	957,600	hour			hour						
E- 2	Backhoe	0.6 m^3	316,068	hour			hour				1 m^3	133,700,000	month
	Backhoe	1.2 m^3	350,400	hour	1.2 m^3	120,000	hour	160 HP	260,000	hour			
	Backhoe	2.0 m^3	465,600	hour	2.0 m^3	135,000	hour	2.0 m^3	370,000	hour			
E- 3	Tractor Shovel			hour			hour	5.4 m^3	390,000	hour			
	Tractor Shovel			hour			hour	10.0 m^3	520,000	hour			
E- 4	Wheel Loader	1.6 m^3	216,000	hour			hour						
	Wheel Loader	2.1 m^3	252,000	hour	2.1 m^3	130,000	hour	2.1 m^3	370,000	hour			
	Wheel Loader	3.5 m^3	525,600	hour	3.5 m^3	145,000	hour	3.5 m^3	430,000	hour	3.5 m^3	52,936,250	month
E- 5	Dump Truck	12-ton	224,400	hour	10-ton	135,000	hour	10-ton	280,000	hour	10-ton	48,587,500	month
	Dump Truck			hour	5-ton	120,000	hour	5-ton	240,000	hour	5-ton	28,392,000	month
E- 6	Truck Crane	10 - 11 ton	84,000	hour			hour						
	Truck Crane	25-ton	219,600	hour	25-ton	120,000	hour	25-ton	650,000	hour			
	Truck Crane	40 - 45 ton	493,200	hour	40 - 45 ton	350,000	hour	40 - 45 ton	840,000	hour			
E- 7	Crawler Crane	40-ton	453,600	hour	40-ton	350,000	hour	140HP	840,000	hour			
	Crawler Crane	50-ton	566,400	hour	80-ton	550,000	hour	80-ton	1,110,000	hour			
	Crawler Crane	100-ton	1,134,000	hour	100-ton	650,000	hour	280 HP	1,300,000	hour	100-ton	207,966,667	month
E- 8	Engine Generator	35kVA	28,571	hour			hour						
	Engine Generator	100 kVA	57,143	hour	100 kVA	185,000	hour	125 kVA	10,000,000	month			
	Engine Generator	200 kVA	71,429	hour	200 kVA	225,000	hour	265 kVA	16,000,000	month			
E- 9	Diesel Pile Hammer		78,000	hour		220,000	hour	5-ton	24,000,000	month		128,823,333	
E- 10	Electric Vibratory Pile Driver		150,000	hour		185,000	hour	90 kW	65,000,000	month			
E- 11	Hydraulic Pile Hammer					225,000		7-ton	33,000,000	month		120,725,000	
E- 12	Motor Grader	135 HP	408,828	hour		175,000	hour		52,000,000	month			
	Road Roller	12-ton	336,828	hour			hour						
E- 13	Tyre Roller	10-ton	351,228	hour		380,000	hour		32,000,000	month			
E- 14	Flat Barge (300 ton)		180,000	month		280,000	hour		120,000,000	month			
E- 15	Flat Barge (500 ton)					345,000	hour		140,000,000	month			
E- 16	Flat Barge (700 ton)					550,000	hour		200,000,000	month		132,142,857	
E- 17	Tug Boat					285,000	hour	850 HP	120,000,000	month		285,500,000	
E- 18	Grab Dredger					3,200,000	hour		350,000,000	month		231,470,000	
E- 19	Crane Barge					320,000	hour	50-ton	10,000,000	day		461,146,667	
E- 20	Hopper Barge					385,000	hour	800 m^3	240,000,000	month		106,250,000	
E- 21	Concrete Batching Plant		3,242,880	day			hour						
E- 22	Crushing Plant		5,136,000	day			hour						
E- 23	Screening Plant			day			hour						
							hour						

* Excluding Fuel and Taxes.

** day = 7 hours
month = 200 hours

Source: JICA Study Team

(4) Basic Cost of Project Works

1) Construction Works

The breakdown of unit costs of the construction works are to be prepared by accumulating costs of labour, materials, equipment and also the indirect costs such as general temporary works, overheads profit and so on.

The combined cost for major construction works is estimated from the costs of labour, required materials, required construction equipment, and the site expense of labour and equipment. The utilities cost of such as water, electric power and drainage refers to the other projects in the equivalent scale.

In addition to the construction cost and procurement cost, the engineering fee for the detail design and construction supervision, physical contingency and VAT are estimated in this study. The engineering cost for survey, detailed design and construction supervision is assumed as about 3 % of the direct construction cost in this case of port development. The physical contingency is assumed as 10 % for the construction cost.

Table 5.1.8-3 Combined Cost for Major Construction Works

(Direct Construction Cost; Source: Estimate by JICA Study Team)

Item	Description	Unit	Unit Cost (1,000 Rupiah)	Unit Cost (in US Dollar)
North Kalibaru Container Terminal				
Breakwater (-10 m)	Rubble mound; Tetrapod 6.3 ton	m	311,617	34,624
Breakwater (-7 m)		m	242,232	26,915
Quay Wall (-15.5 m)	RC Deck-on-pile	m	466,726	51,858
Seawall (-6 m)		m	41,310	4,590
Dredging (Phase I, II)	Cutter suction with Hopper Barge	m^3	76.0	8.5
Dredging (Phase III)		m^3	54.2	6.0
Reclamation	Mountain sand from Banten	m^3	138	15.3
Cilamaya Container Terminal				
Breakwater (-7 m)	Rubble mound; Tetrapod 3.2-ton	m	212,628	23,625
Breakwater (-6.5 m)	Rubble mound; Cube Block 2-ton	m	161,152	17,906
Quay Wall (-15.5 m)	RC Deck-on-pile	m	466,726	51,858
Quay Wall (-12.5 m)	RC Deck-on-pile	m	357,725	39,747
Seawall (-4~ -6 m)		m	108,837	12,093
Dredging	Cutter suction with Hopper Barge	m^3	51.4	5.7
Reclamation	Imported sand	m^3	154	17.1
Tangerang Container Terminal				
Breakwater (-7.5 m)	Rubble mound; Tetrapod 2-ton	m	200,460	22,273
Breakwater (-6 m)	Rubble mound; Tetrapod 2-ton	m	169,052	18,784
Breakwater (-5 m)	Rubble mound; concrete block	m	325,361.	36,151
Quay Wall (-15.5 m)	RC Deck-on-pile	m	466,726	51,858
Quay Wall (-12.5 m)	RC Deck-on-pile	m	357,725	39,747
Seawall (-4 m)		m	108,837	12,093
Dredging	Cutter suction with Hopper Barge	m^3	45	5.0
Reclamation	Imported sand	m^3	151	16.8

2) Unit Cost of Container Handling Equipment

The unit cost of container handling equipment will include the costs of design, manufacturing, workshop tests, delivery and installation. Procurement Cost for the major equipment is given as follows for the preliminary engineering study (as of October 2010).

Price of imported products such as cargo handling equipment, computer systems and navigation aids are to be estimated based on the CIF Jakarta price and some transportation cost to the development site is considered. Japan or China is assumed as the place of manufacturing.

Table 5.1.8-4 Unit Prices of Container Handling Equipment

Source: JICA Study Team

Item	Description	Unit Price (1,000 USD)
Quay Gantry Crane	Post Panamax type	10,989
Rubber Tyred Gantry Crane	1-over-4 type, 6-lane	1,810
Tractor Head		72
Yard Chassis		29
Top Handler (4-tier)	40-ton, laden container handling	550
Side Handler (5-tier)	Empty container handling	275
Forklift (10-ton)	Laden container handling	88
Forklift (5-ton)	Empty container handling	55
Tank Lorry	Fuelling	176
Bus for Workers		33
Maintenance & Repair Service Car		28
Yard Vehicle		14
Fire Fighting Vehicle		220
Road Sweeper		176

*100 Yen = 11,000 Rupiah; 1 USD = 9,000 Rupiah,

3) Maintenance Cost (Facility, Equipment, Dredging)

The yearly maintenance cost for civil works in the development is set out as 1 % of the facility construction cost based on the annual maintenance fee of the facilities. Also, 3 to 5 % of the procurement cost of the equipment is adopted as the maintenance cost for the equipment.

Access channels and basins of Tanjung Priok Port are maintained by the periodical maintenance dredging, which is financed by PELINDO II and carried out by P.T RUKINDO. The average annual volume of maintenance dredging is summarized in the previous section as shown in Table 5.1.7.1 and the total volume amounts to about 550,000 m3/year (average in 5 years for 2005 - 2009).

The unit price of maintenance dredging is estimated as follows based on the actual contract record of 2008 between PELINDO II and PT RUKINDO. The yearly rate of inflation is assumed 5 % for the period 2008 to 2010 (IMF, World Economic Outlook Database, September 2010 for Indonesia).

Grab Dredging	Rp. 31,000/m^3	(Rp 28,000/m^3 as 2008 price)
Hopper Dredging	Rp. 21,000/m^3	(Rp 19,000/m^3 as 2008 price)

(5) Project Cost Estimate of Each Terminal Development

Project cost of the container terminal development is estimated in line with the development scenarios and phased development plan for each proposed project site, North Kalibaru, Cilamaya and Tangerang.

The first option is to develop required all terminal facilities at Tanjung Priok up to 2030. Three alternative development plans were prepared. Based on such development plans the project cost of each alternative is summarized in the following 1) to 3).

1) North Kalibaru Development (Alternative-1)

Summary of the project cost estimate for development scenario **Alternative-1** of North Kalibaru (development fully concentrate to existing Tanjung Priok Port area) is presented for the Phase I development through Phase III in the following table. The figures include VAT (10 % of the estimated project cost).

Development scenario of the port facility construction is illustrated in Figure 5.1.5-1 in 5.1.5.

North Kalibaru Alternative-1	Project Cost (Million Rupiah)	Project Cost (1,000 USD)	Project Cost (Million Yen)
Phase I	8,230,382	914,487	74,822
Phase II	10,875,477	1,208,386	98,868
Phase III	17,913,623	1,990,403	162,851
Total	37,009,482	4,113,276	336,541

2) North Kalibaru Development (Alternative-2)

Summary of the project cost estimate for development scenario **Alternative-2** is presented for the Phase I development through Phase III in the following table.

Development scenario of the port facility construction for Alternative -2 is illustrated in Figure 5.1.8-2.

North Kalibaru Alternative-2	Project Cost (Million Rupiah)	Project Cost (1,000 USD)	Project Cost (Million Yen)
Phase I	9,125,129	1,013,903	82,956
Phase II	14,272,463	1,585,829	129,750
Phase III	16,262,783	1,806,976	147,843
Total	39,660,375	4,406,708	360,549

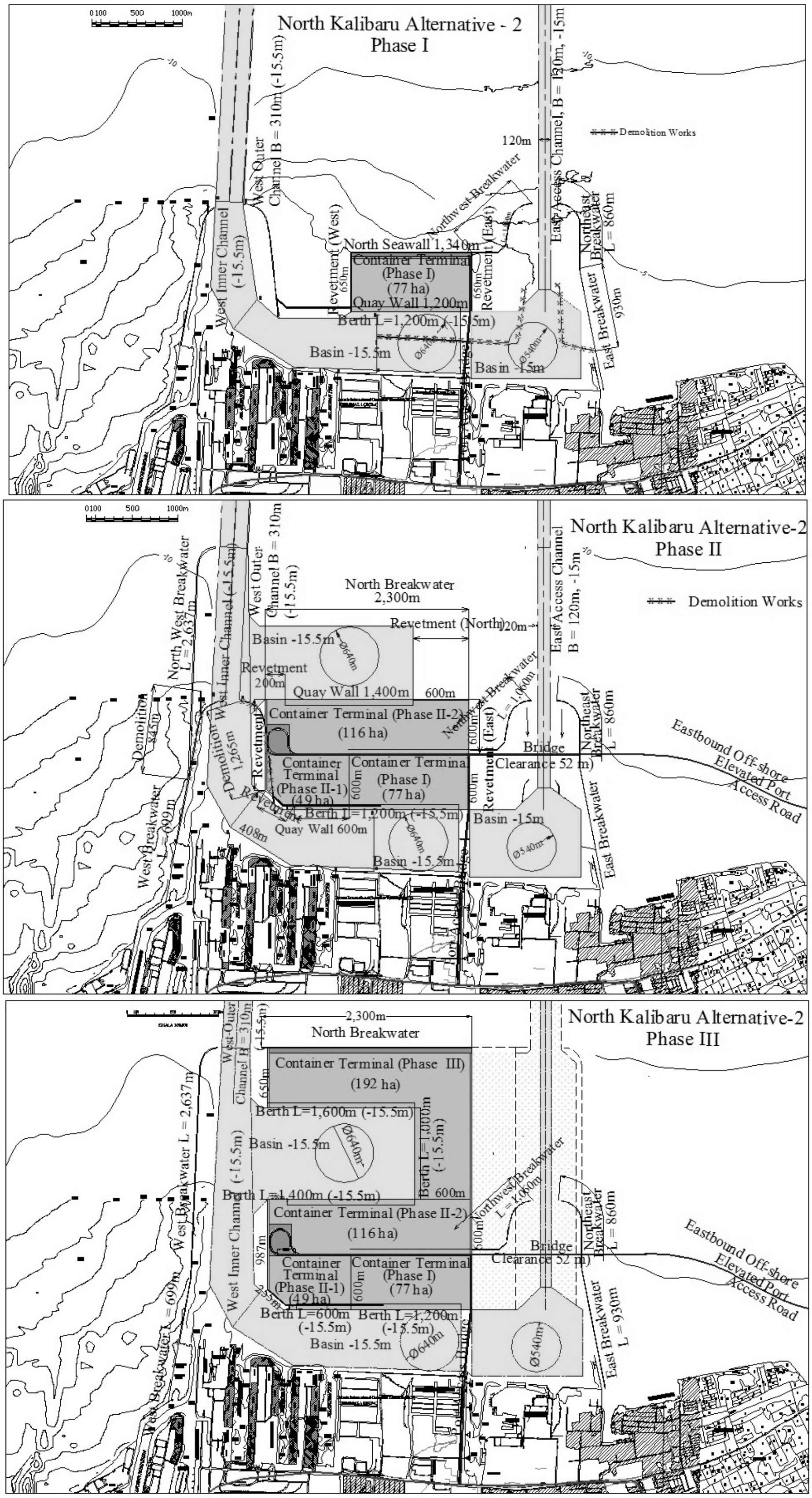
3) North Kalibaru Development (Alternative-3)

Summary of the project cost estimate for development scenario **Alternative-3** is presented for the Phase I development through Phase III in the following table.

Development scenario of the port facility construction for Alternative -3 is illustrated in Figure 5.1.8-3.

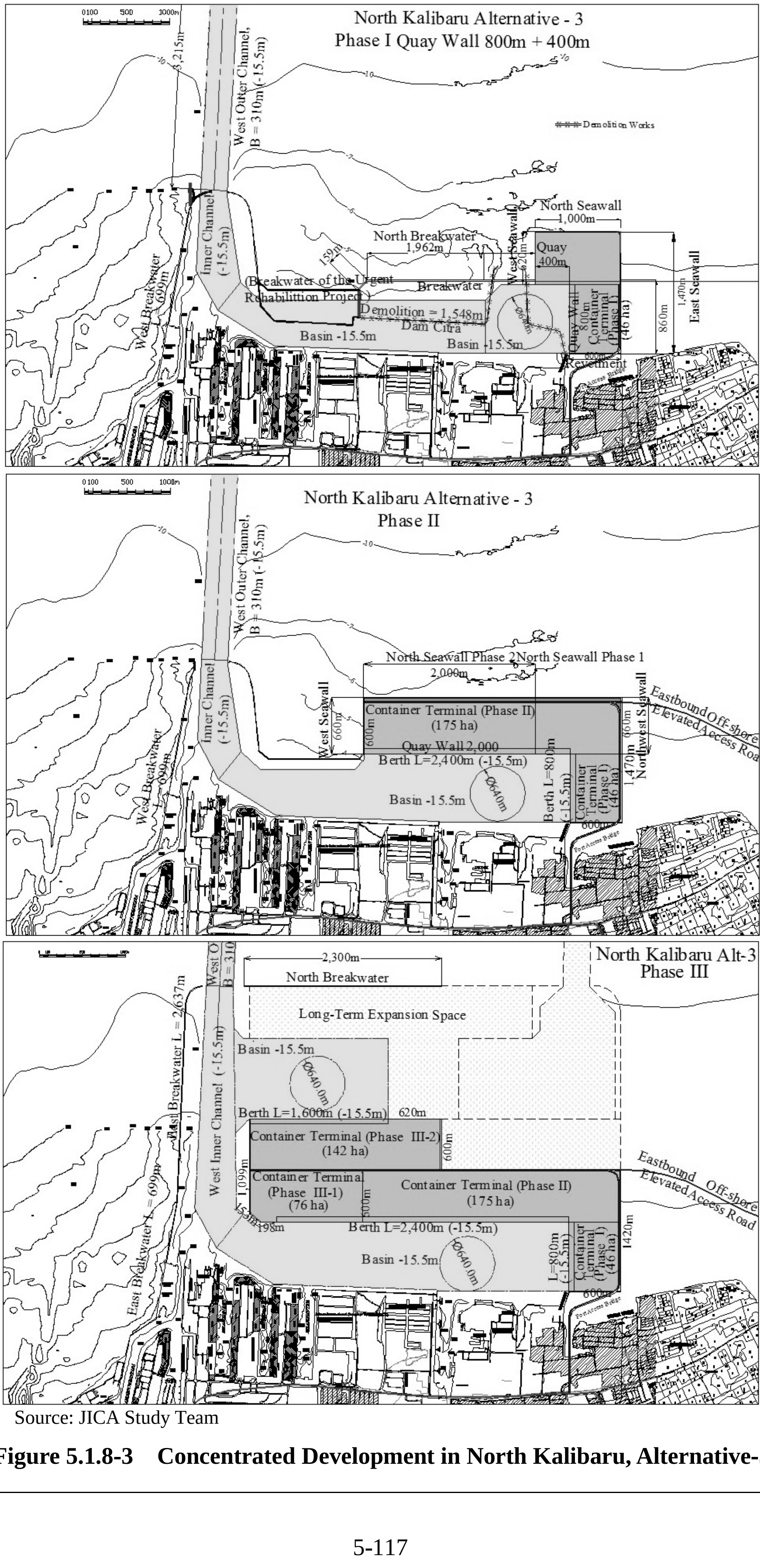
In this case of project cost estimate, the planned quay wall length in Phase I is assumed to have 1,200 m considering the equivalence with Scenario 1 and Scenario 2.

North Kalibaru Alternative-3	Project Cost (Million Rupiah)	Project Cost (1,000 USD)	Project Cost (Million Yen)
Phase I (Quay Wall: 1,200 m)	10,948,783	1,216,531	99,535
Phase II (Quay Wall: 2,000 m)	10,075,848	1,119,539	91,599
Phase III	16,484,841	1,831,649	149,862
Total	37,509,472	4,264,712	340,995



Source: JICA Stuy Team

Figure 5.1.8-2 Concentrated Development in North Kalibaru, Alternative-2



Source: JICA Study Team

Figure 5.1.8-3 Concentrated Development in North Kalibaru, Alternative-3

4) North Kalibaru and Cilamaya

The second development scenario other than development fully concentrated to existing Tanjung Priok Port area is a combination of the 1st phase development of container terminal at North Kalibaru and 1st and 2nd phases of development of container terminal at the Cilamaya site, West Java Province.

Development scenario of the port facility construction is illustrated in Figure 5.1.5-2 in 5.1.5.

Summary of the project cost estimate for North Kalibaru (Alternative-1) Phase I combined with Phase I and Phase II development at Cilamaya is presented in the following table

North Kalibaru and Cilamaya	Project Cost (Million Rupiah)	Project Cost (1,000 USD)	Project Cost (Million Yen)
Kalibaru: Phase I	8,230,382	914,487	74,822
Cilamaya: Phase I	13,072,629	1,452,514	118,842
Cilamaya: Phase II	12,811,356	1,423,484	116,467
Total	34,114,367	3,790,485	310,131

5) North Kalibaru and Tangerang

The third development scenario is the combination of the 1st through 3rd phases of development of container terminal at North Kalibaru and the development of container terminal at the Tangerang site, Banten Province. The target volume in the 3rd phase of North Kalibaru is reduced to 2.3 million TEU/year in this case.

Development scenario of the port facility construction is illustrated from Figure 5.1.5-3 to 5.1.5.

Summary of the project cost estimate for North Kalibaru (Alternative-1) Phase I - III combined with terminal development at Tangerang is presented in the following table

North Kalibaru and Tangerang	Project Cost (Million Rupiah)	Project Cost (1,000 USD)	Project Cost (Million Yen)
Kalibaru: Phase I	8,230,382	914,487	74,822
Kalibaru: Phase II	10,875,477	1,208,386	98,868
Kalibaru: Phase III (2.3 million TEU)	11,353,928	1,261,548	103,218
Tangerang	8,815,333	979,481	80,139
Total	39,275,120	4,363,902	357,047

6) Summary of Project Cost and Choice of Development Scenario

In the first development scenario, among the three alternatives, Alternative-1 has the lowest project cost at 37,009,482 Million Rp.

Second development scenario (combination of the urgent terminal development of Phase 1 at North Kalibaru under Alternative 1 and the medium term and long term development in the Cilamaya site) yields a project cost of 34,114,367 million Rp.

Third development scenario (combination of the terminal development at North Kalibaru, Phases I - III and the long term development in the Tangerang site) yields a project cost of 39,275,120 million Rp.

It is found that the second development scenario (Phase 1 at North Kalibaru and Cilamaya) has the lowest project cost compared with the other two alternative development scenarios.

As a result of detailed estimate of the project cost of respective alternatives and development options, the second development scenario is recommended for the long term port development and logistic strategy in the Greater Jakarta Metropolitan area.

5.2 New Bulk Terminal Development

5.2.1 New Bulk Terminal Development at North Kalibaru

(1) Petroleum Terminal

The volumes of petroleum products to be transferred to a new petroleum terminal in 2030 have been estimated as 4.4 million MT. To handle the above volume for PERTAMINA and additional volumes for the potential dealers other than Pertamina, four berths in total have been planned as follows:

Total berth length:	270 m/berth x 4 berths = 1,080 m
Water depth:	-15.5m

(2) Dry Bulk Terminal

The volumes of dusty dry bulk cargoes to be transferred to a new dry bulk terminal in 2030 have been estimated as 18.4 million MT. To handle the above volume, the total berth length has been estimated to be 915 m. The same water depth of 15.5 m has been adopted in the bulk terminal planning throughout the berth line.

5.2.2 Implementation Schedule of Master Plan

(1) Petroleum Terminal

It is planned to implement the Petroleum Terminal in the latter half of the third phased implementation stage in the period from 2020 to 2030.

(2) Dry Bulk Terminal

It has been planned to implement the Dry Bulk Terminal in the latter half of the third phased implementation stage in the period from 2020 to 2030.

5.2.3 Preliminary Design and Cost Estimate

(1) Preliminary design of dry bulk terminal facilities and petroleum products storage

1) Handling commodities and volume

Dry bulk terminal

The volumes of dusty dry bulk cargoes to be transferred to a new dry bulk terminal and the respective cargo-handling productivities (CHC) in 2030 have been estimated as 18.4 million MT. Its breakdown is shown as follows:

	Volume	CHC
Clinker (mostly export):	3,217,000 MT	800 MT/hr
Gypsum (mostly import):	1,448,000 MT	700 MT/hr
Unloaded Coal (mostly Intra-Indonesia):	7,611,000 MT	400 MT/h
Unloaded Sand (Intra-Indonesia):	7,279,000 MT	200 MT/hr
Total:	18,395,000 MT	

To handle the above volume, one berth for ocean-going bulkers and seven barge berths have been planned as follows:

- One berth for Panamax-type bulkers:
  - Berth length: 270 m
  - Water depth: -15m
- Two berths for coal barges:
  - Total berth length: 240 m
  - Water depth: -6m
- Five berths for sand barges:
  - Total berth length: 500 m
  - Water depth: -3m

Thus, the total berth length has been estimated to be around 1,000 m. To ensure flexible berthing, dry bulk berth has been planned as a continuous berth with the same water depth of 15m.

Petroleum products

The volumes of petroleum products to be transferred to a new petroleum terminal and the respective cargo-handling productivities (CHC) in 2030 have been estimated as 4.4 million MT. Its breakdown is shown as follows:

	Volume	CHC
International Petroleum products (mostly import):	2,217,000 MT	700 MT/hr
Domestic petroleum products (mostly unload):	1,918,000 MT	500 MT/hr
Lubricant oil:	177,000 MT	100 MT/hr
Total:	4,351,000 MT	

To handle the above volume for PERTAMINA, two berths are sufficient. It is said that petroleum dealers other than PERTAMINA are requesting to set up their terminals.

Taking account of such requests, four berths have been planned as follows:

- Total berth length: 330 m/berth x 4 berths = 1,320 m
- Water depth: -17m

2) Objective dry bulk carriers and petroleum product tanker for preliminary design of quay wall

Dry bulk carriers

Taking account of types of bulk cargoes such as clinker and gypsum which will be potentially handled at a new bulk terminal to be placed off North Kalibaru, suitable vessel type has been considered to be Panamax-type rather than larger type of Cape-size bulk carriers. Representative principal dimensions of Panamax-type bulk carriers have been summarized in Table below.

Table 5.2.3-1 Representative Principal Dimensions of Panamax-type Bulk Carriers

Vessel type	DWT	Draft (m)	LOA (m)	Beam (m)
Panamax type	80,000	13.0	240	32.2

Source; Study team

Required channel widths for Panamax-type bulk carriers according to PIANC Guidelines and the Deviation Angle Method are described in Table 4.5-9. The required water depth for Panamax-type bulk carriers has been estimated to be 15 meters

Corresponding dimensions of required berthing facilities have been summarized below.

- Berth length: 270 m
- Water depth: -15 m

Petroleum Product Tanker

Aframax-type petroleum products tankers which are typically used in long-distance transportation of petroleum products are considered to potentially call at the new petroleum terminal. The principal dimensions of objective tanker are shown in Table 5.2.3-2.

Table 5.2.3-2 Representative Principal Dimensions of Aframax-type Products Carriers

Vessel type	DWT	Draft (m)	LOA (m)	Beam (m)
Aframax type	120,000	15.5	250	44.0

To accommodate the design vessel, the following berth dimensions are required:

- Berth length: 330 m
- Water depth: -17 m

3) Facilities planned for bulk terminal development

Dry Bulk Terminal

- Quay wall ; Length 1,010 m, Depth -15.5m
- Stock Yard development by Reclamation, Revetment; Yard Area; Backup distance 200 m, length 900 m along the berth, Area 18 ha. Concrete pavement with drainage system
- Terminal Inner Road; The terminal inner road is planned to have 12 m width for 3 lanes with two-way traffic and concrete pavement (t=20cm) with gravel coarse foundation (t=30cm) to sustain the standard trucks (H22-44) wheel load of 8.0 ton/wheel. The road is planned to be constructed between the revetment wall and edge of bulk cargo stock yards on the north sides with a length of 1,010m.

Petroleum Product storage terminal

It is assumed that the port authority will develop the facilities of petroleum yard with following arrangement.

- Quay wall is planned as a dolphin detached type structure, which shall be designed by the users according to their usage and type of tankers to call.

Tentatively the necessary water front distance is planned to develop 4 berths.

There will be a breakwater (New Dam Tengah) on the inner channel side, which will be developed under URPT and can be used as revetment of the reclaimed land for petroleum products storage yard.

Storage yard will be developed by reclamation and construction of seawall and revetment; Yard Area is planned to have a backup area of 600 m and water front length of 1,320 m along the berthing facilities. The area will be about 60 ha.

The yard pavement shall be determined according to the type of users.

- Terminal inner road will be developed with drainage system, which is included as part of the project.

4) Design Criteria

All the applicable design criteria of the above facilities except the following is the same criteria as described in Chapter 5.1.2, since its construction site is located adjacent to the new container terminal berth at North Kalibaru.

Objective ship size as shown in Table 5.2.3-1 above for dry bulk carrier,

Loading conditions such as surcharge on the dry bulk berth is set at 25 kN/m2 considering the type of bulk cargo handling equipment, while it is set at 35 kN/m2 on the dry bulk stock yard.

The design criteria for preliminary design of petroleum tanker berthing facilities will be decided by users.

5) Design of Quay wall structure of bulk cargo

As a result of the comparison study, "Concrete deck on Steel Pipe Pile type" is considered suitable as the selected quay wall type for the new bulk cargo terminal due to similar soil conditions, seismic conditions at site, which is located adjacent to the new container terminal. The quay wall structure is planned to be constructed in front of the rubble mound type breakwater (Dam CITRA), which is required as part of development of the new container terminal at North Kalibaru. The typical cross section of breakwater is shown in Figure 5.1.2-12.

The retaining wall between the back up yard reclamation and quay wall is planned by steel sheet pile to protect the channel.

The dead and live load per pile is estimated around Pv=250 t/pile. This loading condition is applied for preliminary design of new bulk cargo berth.

The particulars of the quay wall are described in the Table below. The typical cross section of the planned berth is shown in Figure 5.2.3-1. The new bulk berth is planned on the same line as the new container berths

Table 5.2.3-3 Particular of Quay wall of Bulk Cargo

Location	North Kalibaru New Terminal in Tajung Priok
Target Throughput	18, 395,000 Ton/year
Berth Length	1,010m
Berth Water Depth	CDL-15.5m
Number of Berths	1 for Panamax, 2 for coal barge, 4 for sand barge
Target Vessel Size	80,000 DWT
Quay wall Structure	Concrete Deck on Open Steel Pipe Pile Ø1200,t=20mm, driven up to - 32.50m DL (N-,50), with retaining wall by concrete blocks on top of rubble mound
Crown Height of Quay wall	CD+3.50m
Terminal Yard Backup Length	200 m
Bulk handling cranes	Movable cranes lifting and grab type
Fender	Rubber Fender 1150H, @12m
Bollard	100 tons @ 30m

Source: JICA Study Team

6) Yard Development by Reclamation for dry bulk terminal

New seawall on the north side and east side revetment of reclaimed land

The yard for new bulk terminals is planned to be developed by reclamation to the west of the new container terminal at North Kalibaru. The new sea wall on the north side (L=1,200m) will be constructed to protect reclaimed land from the wave and sediment material carried by the current with rubble stones piled up and armour stones thereon.

The soil condition of the foundation at the upper layer of depth -4.5m is soft and loose grey sand.

The same type of seawall structure for reclamation as adopted for the new container terminal at North Kalibaru is selected due to the location.

The seawall structure is designed with the same concept as planned for the new container terminal at North Kalibaru.

The north side seawall is constructed with the same type (rubble stone mound with PVD for sea bed soil improvement) as planned for the new container terminal. In the land side area behind the seawall the reclamation sand is filled up to +1.50m (MST +1.00) and about 15 m away from the revetment the ground level is gradually increased to +3.50m (MST + 3.0m).

The revetment on the east side as boundary of the petrochemical products storage area is planned by the same type (rubble stone mound type with PVD for sea bed soil improvement) as planned for the new container terminal at North Kalibaru.

The typical cross section of north side seawall is shown in Figure 5.2.3-2 and of the east side revetment is shown in Figure 5.1.2-15.

For development of the petroleum yard, the seawall for the petroleum storage yard on the north side and revetment on the east side are required for development of the reclamation. Under this Study the same type of seawall and revetment structures of the bulk terminal are applied for petroleum storage yard protection.

Reclamation works

Reclamation works will be carried out by filling material such as quarry run and rubble stones taken from the quarry around the project sites. The in fill materials will be transported by dump trucks from the existing quarry near the project site.

The infill material should be filled from the existing sea bed up to +2.0 m from CDL. Average thickness of reclamation will be 6 to 7 m. Average elevation of the planned yard after pavement will be +3.5 m (MSL+3.0m).

The soil improvement for the reclamation area is considered by the Plastic Vertical Drain (PVD) method at the foundation of the seawall, revetment and terminal inner roads areas. This method is one of the most practical methods of compaction for granular material.

The users shall select type of soil improvement of bulk storage area, building area and other facilities considered necessary according to their usages.

During the reclamation works, the silt protector shall be placed in the water area in order to prevent the proliferation of water pollution.

Yard Pavement

Based on the operation planning inside the bulk cargo storage area and petroleum storage area, the pavement type shall be planned and selected by users according to their usage of respective areas. The pavement of the terminal inner road will be planned and developed by the land developer (Port Authority), which shall be sustaining the following wheel loads as the critical condition for each type and area of the pavements.

Table 5.2.3-4 Critical Wheel Load for Pavement Design

Area Particulars	Access / Service Road	Berthing Area	Stock yard
		Berth / Apron	
Critical Wheel Load Type	Standard Truck (H20-44)	Standard Truck (H20-44)	Forklift Truck (25 tf)
Critical Wheel Load (ton)	8.0	8.0	12.8
Pavement Type	Concrete	Concrete	Concrete

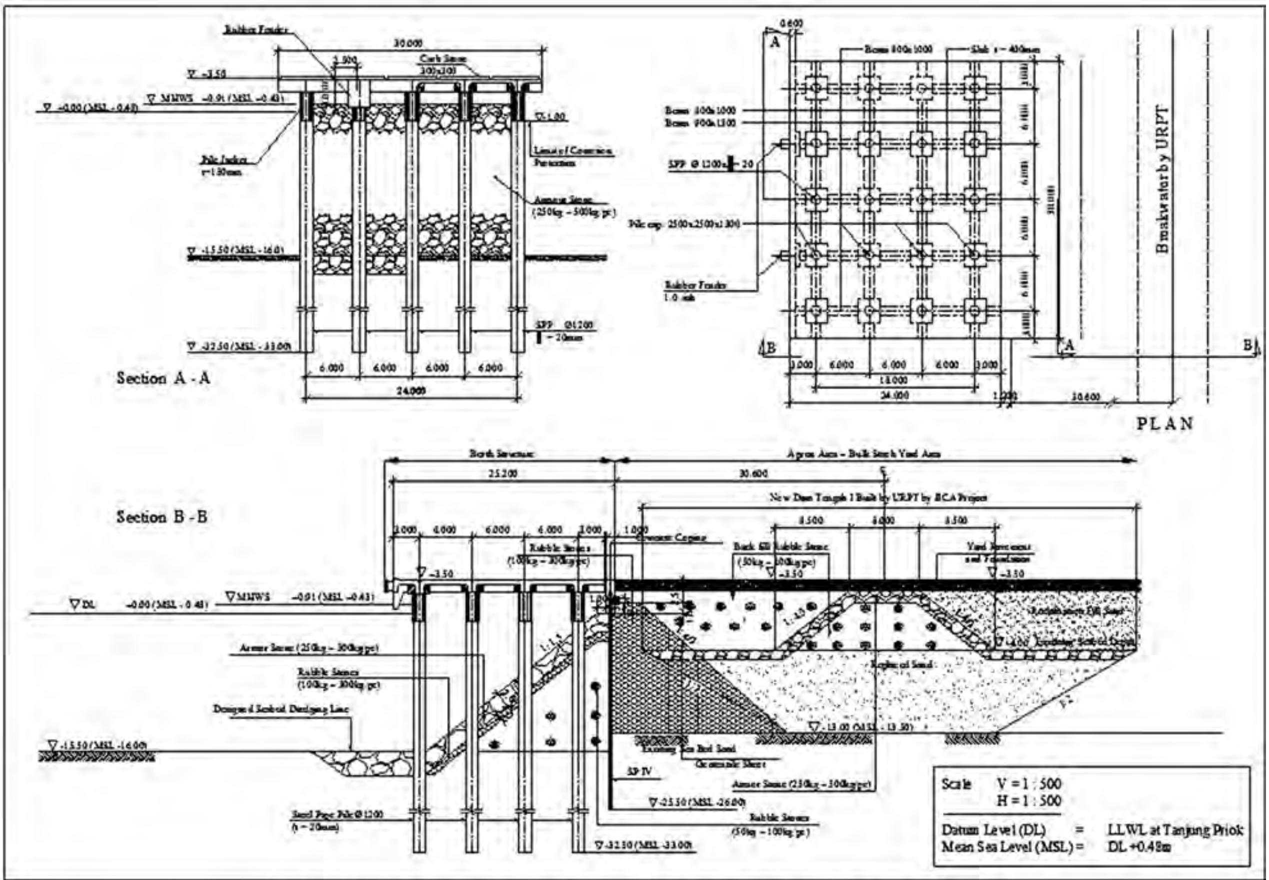
7) Cargo handling equipment for dry bulk cargo

For loading and unloading clinker (export) and gypsum (import) on the berth the following type of handling equipment is tentatively considered for preliminary design of berthing facilities. Required number and type of such equipment shall be determined depending on the progress of demands and user’s requirement.

Table 5.2.3-5 Applicable Typical Handling equipment for Dry Bulk

Crane lifting capacity	20 ton x 21.5 m working radial
Grab lifting capacity	25 ton x 18.8 m working radial
Loading arm length	About 30m
Height of crane, width	About 25 m, control room height; about 13-15m, Width between wheel on both sides; 9.0 m

The suitable unloading equipment of petroleum products on the working platform and dolphins at each berthing facilities will be determined by each user.



SP Type Quay wall Structure (-15.5m CDL) for Bulk Cargo at North Kalibaru

Figure 5.2.3-1 Typical Plan and Section of Bulk Cargo Berth (-15.5m) at North Kalibaru

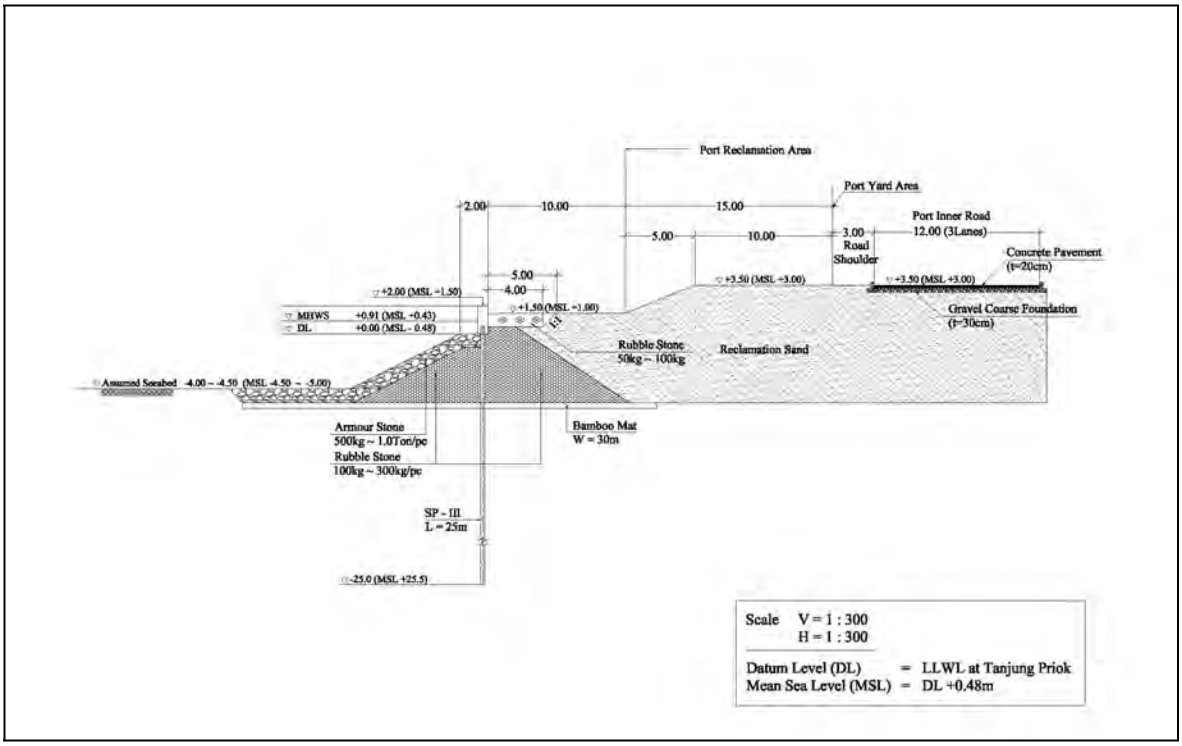


Figure 5.2.3-2 Typical Section of Seawall for Bulk Terminal at North Kalibaru

(2) Preliminary Cost Estimate of Bulk Terminal Development

Preliminary project cost estimate is carried out for the Bulk Terminal development in Tanjung Priok. The development is assumed to be implemented following the Container Terminal development at North Kalibaru (Phase I of Alternative-1) targeting the bulk cargo and petroleum cargo demands in 2030.

The following work items are taken into account in the preliminary cost estimate of the terminal development.

Table 5.2.3-4 The Project Components of Bulk Terminal Development

	Facilities Development	Scope of works	
1	Breakwater and Seawalls	Demolition of Dam Barat:	535 m, existing breakwater sheltering West Entrance of Port
		North Seawall:	2,210 m, protection seawall behind Petroleum Terminal
		Revetment:	725 m, West end of terminal along Channel and Basin
2	Dredging	West Channel:	2.13 million m3, to deepen and widen West Channel
3	Bulk Terminal	Quay Wall:	915 m, SP type Quay Wall, -15.5 m
		Reclamation:	1.89 million m3, yard construction with soil improvement
		Yard Pavement:	18 ha
4	Petroleum Terminal	Quay Wall (revetment)	1,080 m, -15.5 m, without Berthing structure
		Reclamation	11.45 million m3, yard construction with soil improvement
		Yard Pavement:	109 ha
5	Terminal Inner Road	Bulk Terminal:	3-lane (18 m wide) x 915 m behind Bulk Terminal
		Petroleum Terminal	3-lane (18 m wide) x 2,210 m behind Petroleum Terminal
6	Utility Facilities	Lump Sum	

Preliminary cost estimate is presented in Table 5.2.3-5. Total project cost is estimated as 6,274,071 million Rupiah (around 697 million USD, or 57,037 million Yen).

Table 5.2.3-5 Preliminary Cost Estimate of Bulk Terminal / Petroleum Terminal

Description	Unit	Quantity	Local Portion (1,000 Rupiah)	Foreign Portion (1,000 Rupiah)	Summation
1. General Cost			**155,530,618**	**84,120,710**	239,651,328
2. Direct Construction Cost					
(1) Breakwaters					
Demolition of Dam Barat	m	535	7,490,000	11,235,000	18,725,000
(2) Seawalls					
North Seawall	m	2,210	140,803,994	101,375,881	242,179,875
Revetment	m	725	23,762,588	4,065,416	27,828,003
(3) Port Inner Road	m	3,150			
(4) Dredging Channel and Basin					
Deepening (-15.5 m)		2,134,306	69,900,250	92,332,045	162,232,295
(5) Bulk Terminal					
Quay Wall	m	915	354,239,089	213,728,537	567,967,625
Yard Construction	ha	18			
Reclamation (DL+3.5 m)	m^3	1,350,000	132,285,682	53,493,982	185,779,664
Reclamation (Surcharge 3 m	m^3	540,000	52,914,273	21,397,593	74,311,865
Soil Improvement	m^2	180,000	21,668,790	9,286,624	30,955,414
Passage Pavement	m^2	180,000	68,040,000	45,360,000	113,400,000
(6) Petrol Terminal					
Revetment (Quay Wall)	m	1,080	230,217,451	172,593,454	402,810,905
Yard Construction	ha	109			
Reclamation (DL+3.5 m)	m^3	8,175,000	801,063,297	323,935,778	1,124,999,075
Reclamation (Surcharge 3 m	m^3	3,270,000	320,425,319	129,574,311	449,999,630
Soil Improvement	m^2	1,090,000	131,216,561	56,235,669	187,452,229
Passage Pavement	m^2	1,090,000	412,020,000	274,680,000	686,700,000
(7) Utility Faclities					
Utility Faclities	l.s.	1	252,409,046	130,028,595	382,437,641
Sub-total of Direct Cost (DC)			**3,110,612,355**	**1,682,414,207**	**4,793,026,562**
3. Project Related Expenses (PE)			**435,485,730**	**235,537,989**	**671,023,719**
(1) Engineering Services	l.s.	1	93,318,371	50,472,426	143,790,797
(2) Contingency	l.s.	1	311,061,236	168,241,421	479,302,656
(3) Administration Cost	l.s.	1	31,106,124	16,824,142	47,930,266
4. Total Construction Cost			**3,701,628,703**	**2,002,072,906**	**5,703,701,609**
VAT			370,162,870	200,207,291	570,370,161
Grand Total of Bulk and Petroleum Tertminals Develo			**4,071,791,573**	**2,202,280,197**	**6,274,071,770**

1 USD =	9,000	Rupiah	**697,119**	***1,000 USD**
1 Yen =	11,000	Rupiah	**57,037,016**	***1,000 Yen**